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Laps.

Laps—judging from what I have seen—seem to be among the tools in the machine shop that are pretty generally neglected, except in shops where so much use is made of them that they are an actual necessity. There are few machine shops in which laps of some form, at some time or other, are not used, and if a set were kept in the average shop, a satisfactory use would be made of them.

I have proved this to my own satisfaction several times, as I have had jobs where the lapping of holes and spindles or plugs was a large part of my work, and where, after I had accumulated a good stock of laps, I was continually being asked by different workmen who had pieces requiring to be lapped, if I had this or that size of lap.

A man would come to my bench with a careworn and anxious expression upon his face, and in his hand, perhaps, a cutter just hardened or a piece with a hole in it he had bored in the lathe as near as he could to the required size. It seemed to be all right in the chuck or upon the face plate, but come to get it upon the bench, it was a little tight; or if a cutter, in hardening the hole which at first was right, now is a little out of round; perhaps he has left it small and ground it out in the Universal grinder, and, as with the lathe job, it wants "just a hair" taken out of it. The lathe job cannot be chucked again or the cutter go back into the grinder. I speak of these cases merely as examples, and not as embracing, even in a small measure, the uses for laps in the shop. Workmen accustomed to using them know their value and the many occasions upon which they can be used to advantage.

My shopmate looks at my row of laps and says, "Say, Jim; got a 1⅛-inch lap? This thing is just a shade small."

I pick out a 1⅛-inch lap, push a mandrel into it, and hand it to him. A great change comes over my friend's face. He smiles now. "Oh," he says, "that'll just do it." He knows how to do the rest, and in a few moments is back again with the lap and mandrel, and very well disposed toward us both—the lap and I.

Now if there is no set of laps, you will see him down upon the floor, pawing over a box at the end of somebody's lathe, or under the bench, rattling around among a miscellaneous collection of chunks of cast iron, brass, copper, lead, etc. The gloomy look gets gloomier, and he talks rather forcibly (you must excuse his French) about there being everything there but what he wants. He has finally to take something larger and turn it down.

When it will just enter the piece he wishes to lap, he files it a little on the end, puts on some oil, and scatters a lot of emery all over the lathe, so as to be sure and get some on the lap, and tries to crowd his cutter, or whatever it may be, on. Of course it sticks and gets hot, and so does he. More oil and emery—more French—by and by it slips on to the place he has turned upon the lap; but there was rather more to come out than he reckoned for, and if he is in luck, he will have room to turn another spot for a lap; if too short, then he must hunt another chunk. This form of lap is what I call the solid-chunk lap, and is one of the meanest I know of.

I have seen them made of wood and sawed in the end for three or four inches of their length, with a wedge in the saw slit at the end for adjustment. This makes a lap some like a policeman's club—biggest at one end. Those who have tried this form will appreciate the beauty of this method of adjustment.

The idea seems to be quite generally entertained that a lapped hole *must* be right; but the fact that a hole is lapped is no guarantee of its perfection.

The s. c. lap is made of almost anything that comes handy—cast iron, wrought iron, machine steel, brass, copper or wood, and if any one of them in this form of lap will make a straight hole, it is news to me.

Then there are lead laps, and, in fact, many think that laps must be made of lead. I believe it is more generally used in machine shops. In speaking of laps many understand you to mean lead ones, as though there were no others. They have been used for years in gun barrels and nothing better seems to have been found, but for a set of laps for a machine shop to be arranged in sizes to conform to the reamers and mandrels in use I am decidedly of the opinion that there is something better. I think that soft cast iron is the best material I have used.

I do not wish to be understood as saying that good holes or spindles cannot be made by lead, as I use it in some forms of laps to good advantage, but I think for the use which I have in mind that cast iron is better.

First perhaps it will be well for me to state some of the difficulties I have encountered in the use of lead laps and compare them with cast iron. Lead laps are made in several ways. The most common, I believe, is to cast them in a mold around a taper mandrel with a groove running its entire length, into which the lead flows and prevents the lap slipping. The mandrel is put into an iron or wood mold usually made in halves. At each end for a short distance the mold fits the mandrel or is made to by inserting a narrow ring. This holds the mandrel central in the mold and retains the lead. When the lead is cool the mold is opened and the lap turned to size on the mandrel.

Among the faults I have found with lead laps for lapping holes is their liability to lose their form. My experience has taught me that a lap will produce better results if it is kept as near to an even diameter its entire length as possible. I have never got good results from a lap that is "off" in this respect. I try to keep them as near straight while using as I can by reversing the piece to be lapped on inside work and by reversing the lap on outside work as often as convenient and if I find the lap still uneven I make it right by turning, grinding or filing. I have found it much harder to keep a lead lap of an even diameter than a cast iron one, and for these reasons I slit a cast iron lap and usually a lead one. When the lead lap is enlarged by forcing the taper mandrel through it, there are times when it does not respond to a light tap and it is given one a little harder. It takes some more force to start a mandrel in a lap than it does to keep it going, as

in most cases with things that move, and the mandrel sometimes goes too far; then it has to be driven back and perhaps out—the lap shut up and the mandrel again adjusted or the lap reduced by filing or turning. A cast iron lap has sufficient elasticity to close on the mandrel when it is forced back, and that is all that is necessary to do to reduce the size of the lap.

Lead laps enlarge most, as the taper mandrel is forced into them to increase the diameter at the back end where the mandrel is largest and the lap consequently thinnest. This fault is not nearly so apparent in cast iron laps.

To ensure, as far as possible, the even enlargement of laps of either cast iron or lead the mandrel should fit the lap its entire length. If it does not, it will stretch the lap most at the places where it fits.

After the lap is fitted to the hole to be lapped the addition of the cutting material—usually emery—as it imbeds itself in the lap will enlarge it enough to cause it to cut as much as it should, and as it enlarges the hole the lap is removed, wiped and adjusted again. I think laps quite often are run too fast. I believe better results can be obtained at a moderate speed; the work does not get so warm, and I think the laps cut faster; the emery stays upon the laps better and does not fly off. As far as cutting is concerned, I think cast iron ones cut as fast as lead ones. A lead lap must usually be held in the hand while the mandrel is being rapped through it. If it rests upon its end upon a block while being driven it is apt to swell or get pinched at that end—a cast iron one can be rested in this way without injury or can be put in a mandrel press and adjusted in that way.

The tools necessary for lead laps usually are a ladle, some molds and taper mandrels. Iron molds are all right, but wooden ones used by some soon char out and becomes useless. For a set of cast iron laps a few tools are necessary. They are not very expensive and when once

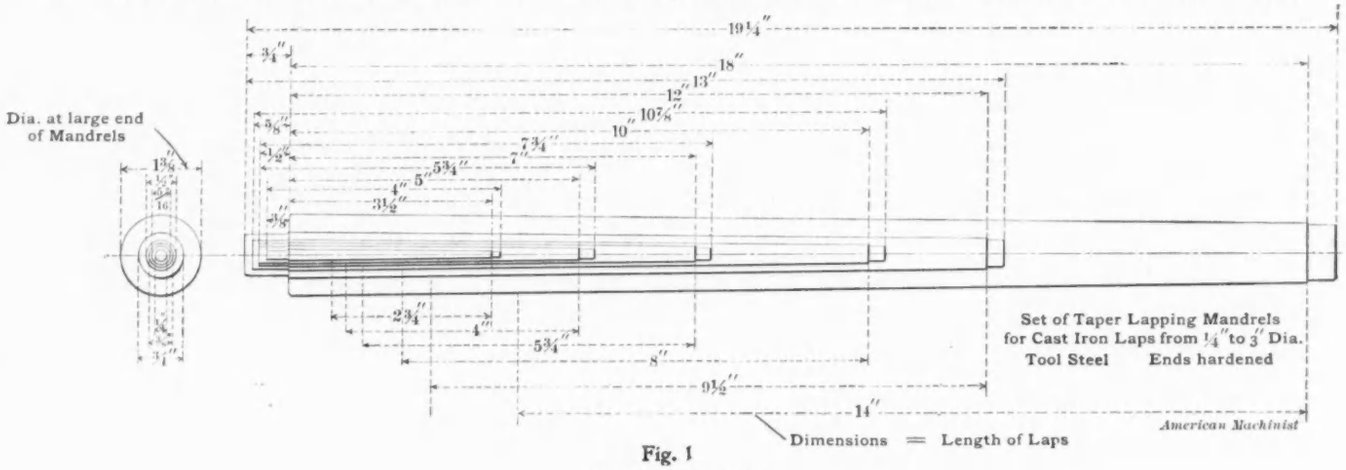
Dia. at large end of Mandrels
Set of Taper Lapping Mandrels for Cast Iron Laps from ¼″ to 3″ Dia.
Tool Steel Ends hardened
Dimensions = Length of Laps
American Machinist

Fig. 1
ARBORS FOR LAPS.

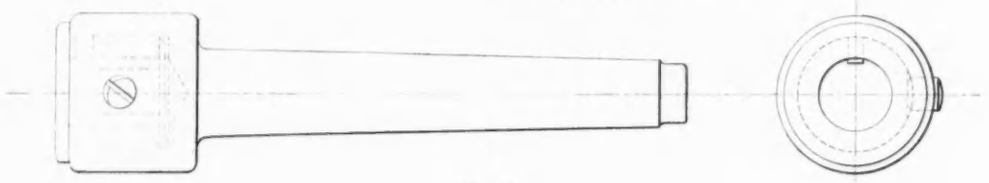

Fig. 2

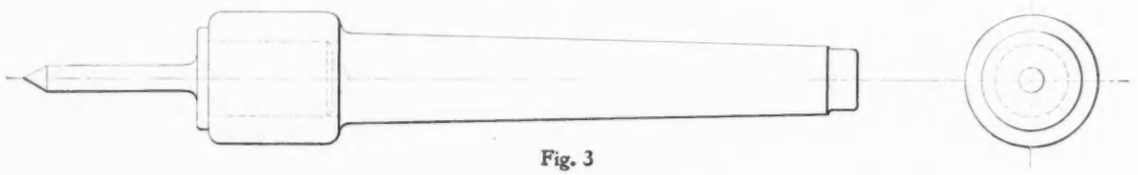

Fig. 3

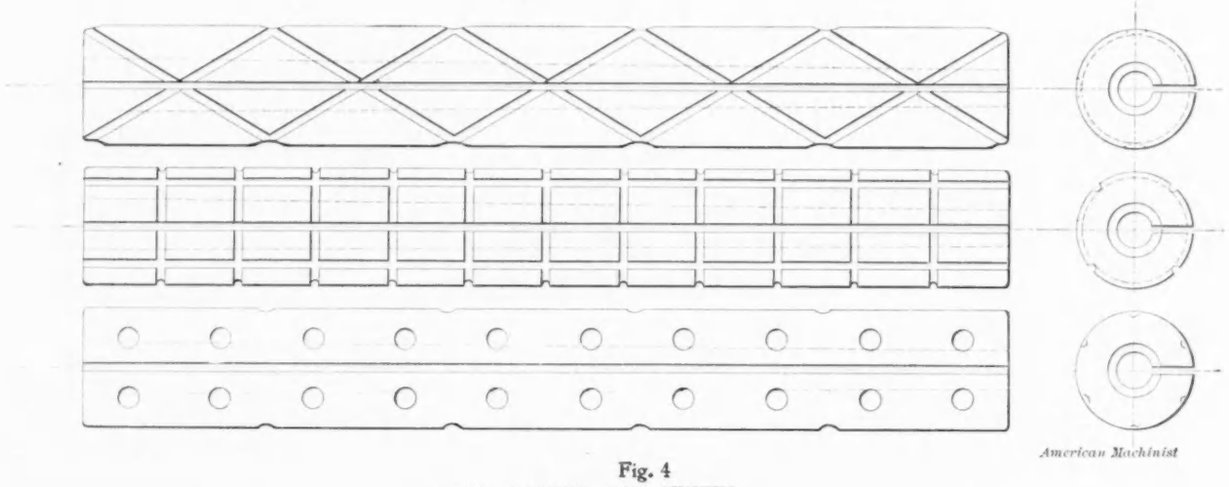

Fig. 4
LAPS, DRIVER AND CENTER.

made seldom or never have to be replaced.

Six taper mandrels, reamers and reamer drills are all that are actually necessary for a set of laps to be used in connection with the usual sizes of reamers and mandrels from ¼ inch to 3 inches diameter. I have used some additional rigs that I have made from time to time, and that I have found convenient in lapping generally, which I will speak of later.

A handy form in which to have cast iron for hole laps is in round pieces of different diameters, 18 or 20 inches long.

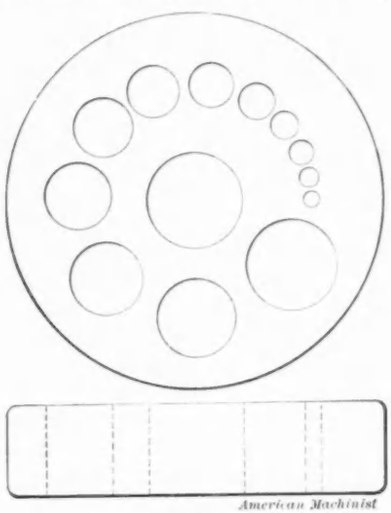

Fig. 5

The laps can be cut from them, chucked, drilled and reamed.

From ¼ inch to ½ inch diameter I use copper or brass; from ½ inch up, cast iron. I make the laps for holes as long as I can conveniently make the taper reamer. Fig. 1 shows a set of taper mandrels for laps from ¼ inch to 3 inches diameter. The smallest takes laps of ¼ and 5-16 inch diameter, and the others in regular order, ⅜ to 9-16, 9-16 to 13-16, 13-16 to 1 5-16, 1 5-16 to 2, 2 to 3 inches. I think this number (six) the smallest that should be used, and two or three more would be better.

In connection with taper reamers for laps, perhaps it may be well to speak of some of the difficulties in making them. They are necessarily long and slim, and difficult to harden without springing, and although to men accustomed to making them there will be nothing new in this, it may be of some assistance to those who are not. In addition to careful heating and cooling, they can be straightened after tempering even if they are quite badly sprung. I cool them first in cold water and then in lard oil, leaving them in the water an instant until the red disappears; then finish cooling in oil; this leaves a softer core of metal in the reamer and more easily straightened. I turn up an emery wheel to fit the flutes and grind them out; this smooths the front face of the tooth, and gives it a much keener edge when the top is ground. After drawing, I place the reamer in the lathe on an old pair of centers shaped up and hardened and kept for such jobs, with a piece of hard wood in the tool post. Warm up the reamer with an alcohol lamp or bunsen burner as hot as you can without starting the color; bring the wood against the high side of the reamer with the cross-feed screw, and spring the reamer until it is true enough to grind. The operation will have to be repeated a few times, trying the reamer as you would a shaft, by revolving it with the hand, on the centers, after springing it. I grind them in the Universal, and grind them round, as I would a taper plug, stoning a clearance by hand afterwards. Previous to this last grinding, the flutes should be again polished out. The first grinding in the flutes is to smooth any roughness left in milling and brighten the surface sufficiently to color in drawing. The second time I pay more attention to smoothing up the face of the tooth for an edge. The taper mandrels are made of tool steel, with the ends hardened previous to taking finishing cut in the ordinary manner.

The drills are long twist drills, and if they cannot be cut in the shop, an ordinary drill may be spliced by turning a short shoulder on its shank and fitting it into a piece long enough for the lap. I solder them in.

Fig. 2 shows a handy chuck for holding the mandrel and lap. I make several sizes of bushings to go with the chuck, with different sized holes in them to fit the different mandrels, one chuck in this way answering for all sizes of mandrels. A screw or pin goes through the bush, whose point just clears the flat spot on the end of the mandrel, preventing it from turning in the bushing. The mandrel and lap can be taken out by simply drawing back the tail-stock spindle and pulling the mandrel from the chuck. A center held in a taper shank collet, as shown in Fig. 3, in the tail stock is handy for inside or outside lapping. It is long enough in one case to run the piece being lapped off upon it, to remove the lap from the lathe, and in the other the lap can be run off upon it to remove the piece from the lathe.

From the emery and oil that works into the center at this end of the mandrel, the center wears considerably, and this is a handy form to repoint and lasts a long time, also being easier to make than the common center. Two or three sizes of them can be used to advantage. With the tools done, cast-iron laps can be made by any boy who has survived two years in a machine shop, with the usual attention from the foreman.

Fig. 4 shows three ways of scoring laps. The spiral can be done in the milling machine, or it can be done well enough with a drill file in the vise. The straight form can be done in the lathe entirely, or the lengthwise scores can be cut in the miller. The drill-spotted lap is center-punched, and then spotted at the drill-press in a V-block going down just to the corner of the lip of the drill. Either of these forms works well, and can be used as found expedient. Laps of ½ inch and under I do not score. A key or feather is not needed in the mandrel, as the laps never turn, except perhaps in laps of small diameter that are quite thin. I find a satisfactory taper for reamers and mandrels to be ¼ inch per foot.

In many cases a set of laps for holes might be all that was needed, and I think would soon prove their value. The laps are not very convenient to hold while slitting them with the ordinary means. I have held them on the bed of the milling machine with two straps having a round nose forged at one end to enter the

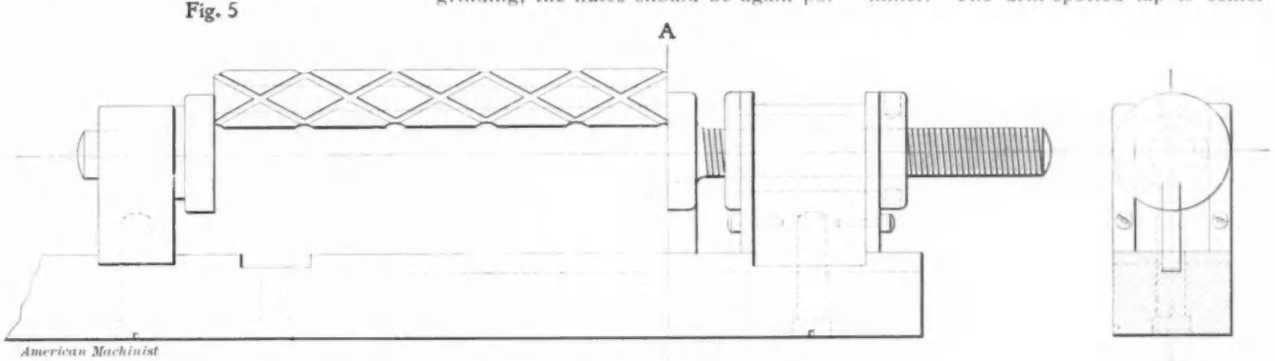

Fig. 6

SPLITTING A LAP.

hole in the lap, resting the lap in the T-slot of the bed or in a V-block. Fig. 6 shows a holder that will take any lap and can be placed in the milling vise. It will not cramp the cutter held in this way by its ends. If the laps are slit on the man-

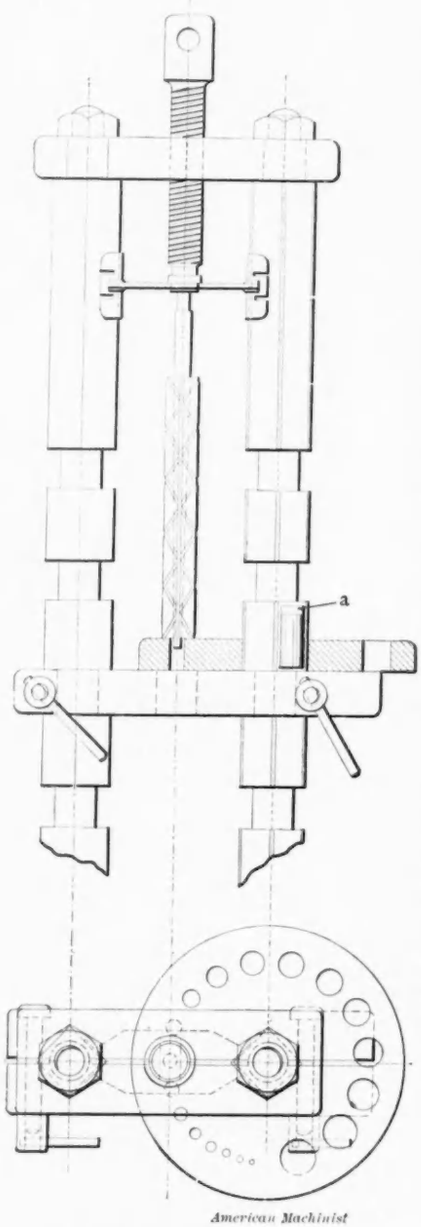

Fig. 7. PRESS FOR LAPS.

drel the machine must be set to the taper of the mandrel, and if you cut through the lap you mark the mandrel. It is an easy rig to make and set.

If the laps are enlarged by rapping the mandrels into the lap, a block like Fig. 5 for the end of the lap to rest on while rapping is handy, or a mandrel press like Fig. 7, which can be held by its lower jaw in the vise in an upright position, or by one of the side bars in a horizontal position—or in still another way by fastening a plank upon the bench so it will project enough beyond to allow the side bars to drop through two holes cut in the plank. This holds it in an upright position.

Fig. 7 shows the construction of this press. The necked side bars are 1½ inches square, of machine steel left rough, centered and necked in. The right-hand one has the corners turned off slightly to allow the anvil shown in section to turn on it. It is held in place by the hickory wedge shown at (*a*).

The follower is made of sheet steel—the sides about 3-64 inch thick and the connecting piece ⅛ of an inch thick.

That portion of the sides above and below the saw slits is bent at a little sharper angle than a right angle to grip the side bars a little, causing sufficient friction to hold it wherever it is moved. The ends of the pieces should also be turned out a little so the edges will not catch upon the side bars as it is moved up or down them. I prefer a screw to a rack, as it is easier to get a very slight movement of the mandrel when it is needed.

Fig. 8 shows different forms of laps for outside work. Lead in this form of lap does very well, as it is protected by the casting into which it is poured, but even here I do not see but cast iron does just as well. No. 1 Fig. 8 shows a lap casting recessed and filled with lead. The retaining lips in the casting are dove-tailed a little to hold the lead, and a few holes are drilled in the casting for the same purpose. The lead is poured in at the bell-mouthed hole at the top. By making the recessing in this form of lap shallower sheet brass, copper or lead can be forced into it for laps over one inch diameter. The sheet metal can be curved some as it is bent so it will spread out into the dove-tail when forced in. A piece of round stock some smaller than the size to be lapped can be used to force them in place. Get the sheet metal wrapped in place as well as possible, then by putting the round piece in the lap and the whole between the jaws of a vise the sheet metal can be forced into place. Copper or brass should be annealed before putting it into the lap, which may need a little touching up with a scraper or file to bring it to a good bearing on the work to be lapped, after the lapping pieces are in place. In connection with outside laps I may mention a use for them spoken of by Mr. T. R. Almond in the "American Machinist" of November 12, 1896, i. e., their use upon reamers. I have seen a form of reamer very similar to the one he speaks of used quite largely and very successfully.

The flutes were milled sharp—without land. The reamers were hardened, the flutes ground out and then the reamers were ground in the universal grinder cylindrical—just as straight work would be and left about .002 over size, to which they were reduced by lapping with a lap shown at No. 2, Fig. 8. This lap is adjustable and the slit is at such an angle that the teeth of the reamer running backwards do not fall into it. A piece of wood is sometimes put in the slit if the reamer runs at all rough, but this is hardly ever necessary. The reamer comes down to size quite rapidly in lapping, as the surface to be lapped is quite limited. Cutting the reamer sharp with no lands on the teeth, after grinding in the universal, leaves just about enough land, although this can be regulated if too much stock has been left in diameter by grinding with an emery wheel on the front face of the teeth and cutting the lands down as much as desired. All reamer makers pay particular attention to this face of the reamer tooth, and very many machinists making reamers in the shop pay none at all to it, except, perhaps, to stone it a little.

For sizes of outside laps up to 1-inch diameter I use flat bars of cast iron from 18 to 24 inches long, of proper widths and thickness. They are cleaned up all over on the planer and cut off as needed. For larger sizes castings of the form shown at No. 1, Fig. 8, the casting is in one

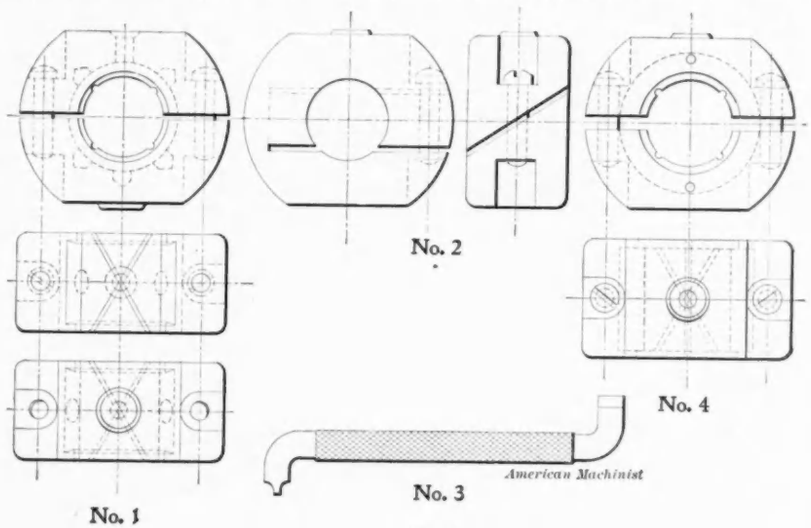

Fig. 8
LAPS FOR OUTSIDE WORK.

piece, a hole cored in it. The screw holes for the adjustment are drilled and tapped, it is then placed on a face-plate, the hole bored and sawed in halves in the milling machine. The boss on one side is for marking the size, and is high enough to allow for two or three removals as the laps wear and are rebored to other sizes. There is no finish on them, the spots where the screw heads rest being swept off with a counter bore.

These forms of outside and inside laps are useful to lap screws and nuts. A nut, sometimes, made for a gage when hardened will close up a little, and can be lapped to size in a few minutes by cutting the proper thread upon an inside lap. A screw can be treated in the same way. Long screws, if they show some slight unevenness that causes the nut to run hard or bind, can be reduced very easily by lapping and made to run uniformly. The halves of the lap must be kept parallel by the adjustment screws, or the lap will come on the thread and bind. In fact, for either screws or straight-wound work, it is well to be careful in this respect. It is easy to do this by watching the openings between the halves of the lap, and keeping it of a uniform width with the adjusting screws. For adjusting these laps I use a screwdriver, shown at No. 3, Fig. 8.

I use frequently for screws over ¾ inch diameter a recessed lap, placing the screw in it and pouring lead around it.

For lapping a large number of pieces of the same size, laps made as shown at No. 4, Fig. 8, are a good form. The lapping pieces are simple rings of metal, and can be replaced at small expense. A pin, shown in each half of the lap, holds the lapping pieces in place.

The length of outside laps must vary some, according to the length of the work upon which they are to be used; but for an average length, I should say a lap of ⅜ inch diameter, ⅝ inch long, 1½ inches diameter, 1½ inches long, a 3-inch lap, 2½ inches long. If the set could contain two or three of each size, I should have one of each size about twice these lengths.

I seldom use emery coarser than 120, and almost always flour. There is considerable difference in the grades of flour by different makers. For finish lapping I use washed emery, and if this cannot be obtained, stir up the flour in the oil, and, after allowing it to settle some, use the top. This is rather uncertain business, as you are apt to get a few particles of the coarser emery in it, and it is exasperating, after getting a plug almost finished, to have one of these rocks come swimming along and plough out a canal the length of your plug. For very close and particular work, roughing and finishing laps are used; but generally by washing the lap thoroughly in benzine, one lap can be made to answer.

The tools for making these laps and the laps themselves could be kept on racks similar to those used for reamers and mandrels and convenient to them. A set of laps, that can be got at and used as easily as the shop mandrels and reamers are, seems to me to be a very good feature.

I have used carborundrum to some extent and with good results, but I do not know if it can be obtained of the same fineness as washed emery.

MACHINIST.

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The Other Side of Two Stories.

SINGLE LINE MANUFACTURING—WHAT REPUTATION MEANS.

Although not always admitted in practice, it is in theory pretty generally admitted, that there are two sides to all stories.

The benefits that accrue to a mechanical business while pursuing but a single line, have been largely dwelt upon, but I fear in many cases as an advertising lever without much thought of the other side.

There are decided advantages in a firm's building nothing but engine lathes, but while the manufacturer who is carrying on such a business is enlarging upon its benefits to the customer as well as to himself, he often fails to remember that there is another side to that story. It is my desire to say a few things on the other side, if for nothing more than to arrest attention and cause people to do a little thinking.

There are many concerns that I could mention, which are carrying on a most successful and profitable business both to themselves and to their customers, and under the sharpest kind of competition, where they do manufacture a variety of articles or machines, and where I believe every article or machine is made to better advantage, both in design and workmanship, than they would be if the concern were making only one article. I will refer to two instances of this kind of industrial manufacture, and others could be cited in the same line of work, but one is as good as a hundred.

A certain man started business in the spring of 1849, making what were called at that time, and perhaps are now, "ox balls," which were used for screwing on the horns of cattle. Among some of the leading articles to-day produced by this establishment are builders' hardware, locks, wood-screws of all kinds, made of brass and iron, machine screws of all kinds, butts, hinges, brackets, bicycle hubs and small parts, bicycle bells, etc.

If I remember rightly, this man started alone, or with one man to help him, and afterwards took one of his brothers with him, and so the work has progressed from that day to this, with a constant advance in the quality of the articles produced, and at a cost which has enabled them to compete favorably with other manufacturers, whether makers of a single article or otherwise, until now, when they are running full, they employ about 1,800 people.

Their corps of engineers is composed of men that have executive ability; has been constantly increasing up to the present time, and, if they now want to improve any line of their goods or start a new line, they have not only one man's ideas, but they can confer with a dozen able men if they so desire, without going out of their own establishment. If, for instance, they have any articles that need nickel-plating, they have a plating department where men are well skilled in the art, and where the work can be done in the best possible manner and at the least cost. I mention the nickel-plating department simply as an illustration, the other departments are equally efficient. With their experience and the force of mechanical facilities which they can bring to bear, I would give it as an opinion that they can produce bicycle parts as well and as cheaply as a concern that does nothing but that one thing, for the reason that they have well organized departments which can take hold of many branches of the work without hazardous experimenting, the expense of which in many cases is almost ruinous.

I would venture to say that no man could start the manufacture of any one article that is made by this establishment and surpass them in quality or economy of manufacture. He might do as well, for as I have already admitted, the single article manufacturer has some advantages.

This subject might be enlarged upon to almost any extent, but the few points I have given will, I believe, be sufficient to lead to thought on the subject.

Now to take up the other line of manufacture, and I have in mind a concern which by no means stands alone in this particular, but will do to illustrate as well perhaps as any other, the point on which I am writing. They are manufacturers of milling, grinding, gear cutting, screw cutting and many other kinds of machine tools. They are also manufacturers of a fine grade of standard tools for accurate measurement and other articles too numerous to mention, and it is not too much to say that this whole line of tools is second to none of its kind.

This business began in 1833, by one man and in a small way. This man had great mechanical ability, but however great the ability of any one man, it has its limits. However, when he gradually brought into his service other talent of the same kind, the ability then to produce the different articles and to perfect the ones he was already making, became evident by the high quality of tools produced, and to-day among the 1,400 or more employés, not only one or two, but a number of talented men can be brought into council, whenever there is a necessity for change of design or improvement in workmanship.

In well regulated establishments such as I have been talking about, the fore-

men of the different departments have one common interest, viz., the success of the business they are engaged in, and the help they give each other in various ways, cannot be too highly estimated. Cordial co-operation for one definite purpose is at least one of the secrets of a successful business. The lack of this has ruined many a concern.

Machine screws can be produced as cheaply and as accurately as elsewhere, for the reason that they have a department which is under control of competent men, and when the screws are finished and need to be case hardened. they have a hardening room, well equipped and constantly running, with a variety of appliances where skilled help are working at one thing from one month's end to the other. I mention this hardening department, as in the case of the nickel-plating room, simply to illustrate the principle.

So, from the time the screws leave the machine until they are ready for use, they are treated in departments which are specially fitted for the particular operation to be performed upon them, and could not be as well nor as economically made, in such small quantities, at least, if the manufacturers were making nothing but screws.

This company also manufactures sewing machines, and it has been said upon many occasions, and I believe truthfully. that the machines are not excelled in quality of workmanship in this country or any other.

They have cutting-off machines that are constantly running for cutting off stock, and departments where holes can be drilled or bored quickly and accurately, grinding departments fully organized, where parts can be carried to be finished, hardening room, nickel-plating room and an organized inspection of the work. Taking all these things into consideration, I believe that any unprejudiced observer cannot fail to see that there are two sides to this question.

There is one side to another story which has been worn thread-bare by many unthinking people, and which I wish to speak about, viz: manufacturers whose means of success is their "reputation." This is often set forth by unthinking people, as though a concern which had once built up a reputation could go on as heedlessly and shiftlessly as they chose, and still be successful. It is like the other story harped on by people who do not stop to think or who have thought and know better, and make the argument to further their own ends.

It is true of a balance wheel that its use and purpose is to carry itself and the machinery attached to it, over hard spots; so with reputation. It may now and then help a concern over a piece of bad designing or bad workmanship, but as in the case of the balance wheel, if the bad spots come constantly, the balance wheel is not only of no value, but becomes a burden to the machine. It is so with reputation.

Manufacturing concerns that have rested upon their reputation have generally gone under, and the wrecks of such concerns are found all over the world.

A reputation that is of any value to a man or a concern, must be kept up by continued effort. If it were not so, it would prove that the public who used their wares, were the most thoughtless of fools in the world.

The best concerns know very well that they cannot keep to the front and prosper without a vast amount of hard work and constant attention to their business; and any man who has stopped long enough to think of it, must come to this conclusion.

The constant prosperity from their first beginning to the present date of some concerns, and the wrecks of others who have trusted wholly to their reputations, are evidence of the truth of this statement.

The reader may wonder, as I have admitted that there are two sides to the story, why I do not enlarge somewhat upon the other side. My answer is that that side has already been enlarged upon —in some cases beyond the facts, and as there has, so far as the writer's knowledge extends, never been anything said on this side, at least in the line in which I have been writing, I think it is not unfair to pay my special attention to the side of the story which I have taken up.

A CASUAL OBSERVER.

▲ ▲ ▲

A Boring-Mill Job as a Trade Secret —Some "Practical" Mathematics.

Our readers have probably arrived at the conclusion before this that we are not much in sympathy with so-called "trade secrets," and it may be surmised that when we receive such a letter as the following, we are disposed to do what we can to dispel the mystery. The latter referred to is as follows:

Editor American Machinist:

We have in our shop a steel casting to turn as per accompanying sketch (Fig. 1). In order to do this, it is necessary to throw over one of the heads of the boring mill to a certain number of degrees and use both feeds, because if we use the head at the proper angle it is too hard on the machine. I am not directly interested in this job, but one day I asked the foreman if he had a rule for setting the head in this manner, and he told me he had, but it was a trade secret. This interested me somewhat, and I have been trying to figure out a rule for so doing, but am not able to do so.

The travel of the tool with both feeds thrown in is about 41° from the horizontal plane. If you can give me a rule for so doing, you will oblige one of your readers.

What I want to know is: At what angle must the head be set so that the travel of the tool with both feeds in will be right to finish surfaces *a a* and *b b* to proper angle, as per sketch, and a rule for obtaining the angle?

In the first place, we may say that there is no trade secret about a job of this kind.

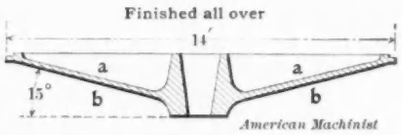


Fig. 1

THE BORING MILL JOB.

It is simply a question of mathematics, and we have yet to see a foreman, or anyone else, who really understood how to solve such a problem and was capable of explaining it, who would not be glad to do so for the benefit of anyone interested in it.

A graphical solution which can be applied to all such problems by anyone who can draw lines accurately and knows how to use the protractor and dividers, is shown in Fig. 2. Draw a base line *A D G* to any convenient length, and from this lay off the line *A C* at the angle produced by both feeds when acting together at right angles, which angle is in this case 41°. From *A* draw the vertical line *A B* to any convenient hight, and at any point on this line draw the horizontal line *B C* to intersect the diagonal *A C*. These vertical and horizontal lines then represent by their relative lengths the rates of the horizontal and vertical feeds. For convenience complete the parallelogram by drawing the vertical line *C D*, which, of course, is the same length as *A B*. We then have a parallelogram *A B C D*, and

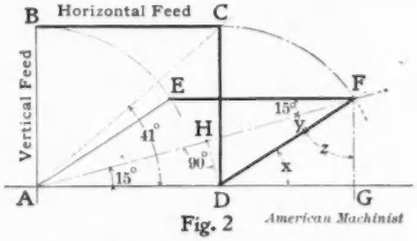


Fig. 2

METHOD OF OBTAINING ANGLE.

A C is the resultant of the two motions represented by the lines *A B* and *B C*. This resultant is in this case at an angle of 41° from the horizontal, and we wish to obtain one that is at an angle of 15°. In doing this we cannot change the direction of the horizontal feed, but must construct another parallelogram whose sides must be of the same length and of such form that its diagonal shall be at the required angle. In doing this, first lay off at the required angle (15°) the line *A F*, and

with D as a center strike the arc $C F$. From the intersection of line $A F$ with arc $C F$ draw the lines $E F$ and $D F$, which are, respectively, equal in length to $B C$ and $D C$. Line $E F$ then represents the horizontal feed, and $D F$ the angular feed, which will produce the resulting motion on the line $A F$, which is the required angle of 15°. Measurement of the angle X with a protractor gives the required angle to which the head must be set. By careful work and drawing the diagram to a scale as large as practicable, results sufficiently accurate for all practicable purposes can be attained.

It is evident that the angle produced by the combined action of the two feeds when acting at right angles to each other must be accurately determined when the problem is solved in this way; but a better method would be to disregard this angle and, instead of using it, determine, first, the relative rates of the two feeds, or their ratio to each other. The graphic solution is then simpler, and will be understood by reference to Fig. 3. We will assume that in this case we find that the

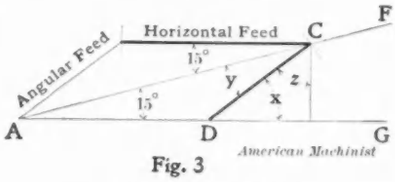


Fig. 3

A SIMPLER METHOD.

horizontal feed is one and a half times as fast as the vertical.

We first draw the horizontal line $A G$ and, at the required angle of 15°, the line $A F$. Then lay off on the line $A G$ the distance $A D$, representing to any desired scale the rate of the horizontal feed. With dividers set to represent the rate of the vertical feed to the same scale, and with D as a center, describe an arc cutting the line $A F$, as shown at C. Then a line joining the points D and C is at the required angle from the horizontal plane, and this angle can be measured by a protractor as before.

If one has not the facilities for a graphic solution, or for any reason prefers to compute the angle, he can make a rough sketch like Fig. 2, and the following solution applies:

$C D = A C \text{ sin. } 41°.$

$A D = A C \text{ cos. } 41°.$

$$\frac{A D}{C D} = \frac{A C \text{ cos. } 41°}{A C \text{ sin. } 41°}$$

$$= \frac{\text{cos. } 41°}{\text{sin. } 41°} = \text{cotang. } 41° = 1.15037.$$

Consequently the horizontal feed is 1.15 times the vertical $\left(\frac{A D}{C D} = \frac{115}{100}\right)$.

From point D draw $H D$ vertical upon $A F$, then $H D = A D$ sin. 15° $= F D$ sin. y, but $F D = C D$. Hence:

$$\text{Sin. } y = \frac{A D \text{ sin. } 15°}{F D} = \text{cotang. } 41° \times \text{sin. } 15°.$$

Sin. $y = 1.15037 \times 0.25882 = 0.29773$.

Angle $y =$ very nearly 17° 20′.

Angle $x = 15° + y = 15 + 17° 20′ = 32° 20′$.

Angle $z = 90 - 15 - y = 90 - 32° 20′ = 57° 40′$.

32° 20′ being the required angle from the horizontal plane.

The mathematical solution for the diagram Fig. 3 is also relatively simple. The general solution is as follows:

$$\text{Sin. } y = \frac{A D \text{ sin. } 15°}{D C}, \quad 90° - (y + 15) = z,$$

$90° - z = x$, the required angle.

In this case, taking $A D$ to equal 1.5 and $D C$ to equal 1, which is in accordance with the conditons of the problem, and finding by reference to a table of natural sines that the sine of 15° is .2588, we may substitute for the first expression the following:

$$\text{Sin. } y = \frac{1.5 \times .2588}{1}$$

Performing the operations indicated, we get .3882, which we find by reference to the same table is practically equal to the sine of 23°. We then have, in place of the second expression, $90° - (23° + 15°) = z = 52°$, and $90° - 52° = 38°$, the required angle from the horizontal plane.

▲ ▲ ▲

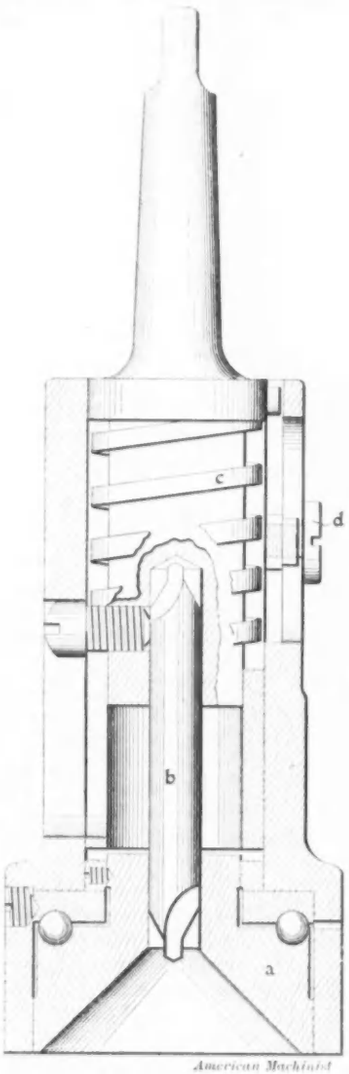
A New Centering Tool.

We give herewith a vertical section of a new centering device which seems well calculated to greatly facilitate that operation.

The use of the combined center drill and countersink has now become quite common in the advanced shops, and this tool makes use of that form of drill and at the same time provides for guiding it precisely to the center of the stock to be centered, whether the latter be round, square, hexagon or any other regular shape. Referring to the engraving, *a* is of hardened steel having on its upper surface a ball track, a hole through its center for the drill and an interior conical surface as shown. The drill is held in place by the screw shown near the upper end at the left, and the entire tool revolves except the piece *a*, which as soon as it touches the work is held by friction and holds the work central. The further feed of the tool onto the work, or of the work into the tool, as may happen, compresses the helical spring *c* and the drill is fed into the work. The operation will be readily understood from the engraving. It is evident that the tool may be used either in drill press or lathe, or, two of them may be used in a double end machine so that both ends of a piece can be centered at the same time. An adjustable stop is provided by which work is countersunk to any desired depth uniformly, regardless of variations in the length of the stock. The tool is provided with a shank turned to fit any specified taper, and is manufactured by its inventor, Morgan Johnson, 9 Morgan street, Hartford, Conn.

A Commercial Laboratory.

There has been established at the Philadelphia Commercial Museums an important and valuable acquisition to the already large collection of valuable exhibits. This will be the addition of a laboratory of tests and technology as an adjunct to the scientific department. It will not be an exhibit in the ordinary sense of the term, but a department that will have for its object the examination and analysis of raw and manufactured products which may be sent to it from any of the countries already represented in its



A NEW CENTERING TOOL.

collections, or from private individuals who wish to determine, through chemical and other tests, the commercial value of the materials presented. The services of this important department will be at the disposal of any person or firm desiring tests or analysis, providing they comply with the requirements of the department relative to the manner of sending samples, and more particularly to the injunction stated, that no certificate given shall be used in any way for advertising purposes.

The Locomotive Link Motion—VII.

BY F. A. HALSEY.

THE ERROR DUE TO THE LOCATION OF THE ECCENTRIC ROD PINS BACK OF THE LINK ARC.

In the previous study of the movement of the link, the eccentric rod pins were assumed to be located in the link arc, and in previous discussions of the subject it has been tacitly assumed that the errors introduced by setting these pins back of the arc are so small as to be negligible. This, however, is by no means the case, this error being, in fact, by far the most important of the three, over correcting, as it does, both the others, and resulting in finally locating the saddle stud inside the link arc, instead of outside where the previous errors alone would place it. This error, like the others, may be best studied by isolating it so far as possible, although it is not possible to separate it from the eccentric-rod error, as will be seen. It is, however, possible to separate it from the connecting-rod error. The nature of the error may be seen from Fig. 24, which shows both forms of link, one having the eccentric-rod pins located in the arc, and the other having these pins located three inches back of the arc, as is customary. The eccentric rods for the former pin are, of course, three inches longer than for the latter. The saddle stud is located over the center of the link arc, as is shown in the diagram, and the links are shown approximately in the positions which they would occupy for a cut off at one-third stroke, the full line links being in position for the rearward stroke of the piston, and the dotted line links being in position for the forward stroke. The movement of the crank is supposed to be by a Scotch yoke, so that no connecting rod errors are introduced. It will be seen at once that the setting of the eccentric-rod pins back of the link arc makes the lines joining the extremities of the arc and the centers of the eccentrics crooked, whereas with this pin located on the arc, this line is of course straight; consequently the effect of placing these pins back of the arc is for the positions shown, to draw the link having the offset pins nearer the shaft than the link which has the pins on the link arc. The action is that of a knuckle joint, any bending of which must draw the link toward the shaft. The rock shaft reverses this action on the valve, so that this drawing of the link toward the shaft pushes the valve away from the shaft. Pushing the valve away from the shaft quickens the cut-off for the front port or rearward stroke, and delays it for the rear port or forward stroke; that is, the effect of the offset pin is to make the cut-off too early in the rearward stroke, and too late in the forward.

This effect will be seen to be the direct opposite of those produced by the connecting and eccentric rods, and it obviously calls for an adjustment of the saddle stud in the opposite direction, as shown in Fig. 25, which shows the position of the saddle stud necessary to equalize the cut-off at one-third stroke with the Scotch yoke connection, the stud being on the concave side of the link, where it is in all cases located in actual engines.

THE FINAL OFFSET.

It is obvious that the final offset of the stud is the resultant of all three. The offset of the eccentric rod pins varies within narrow limits only, but the length of the eccentric rods varies within wide limits. It is obvious that since the error of short rods alone would place the stud farther outside the link arc than long ones, they subtract more from the offset of the stud due to the eccentric rod pins than long ones, the result being that the final offset is less with short rods than with long ones, and this is found to be the case, the offset in actual engines ranging between about five-eighths of an inch and one and a quarter inches, depending on the length of the eccentric rods. The connecting rod also varies in length, but its influence is so small that the variation in its length between usual limits has but little effect on the final result. To illustrate this, Fig. 26 has been constructed, in which the connecting rod has been shortened by trial until the offset of the saddle stud disappeared, placing that stud over the link arc. With the other proportions unchanged, it was found necessary to shorten the connecting rod to a remaining length of three feet before this result was accomplished.

In the diagrams in which the saddle stud is located the following proportions have been used:

Stroke of piston, 24 inches.
Length of connecting rod, 91 inches.
Radius of link arc, 69 inches.
Length of link between pin centers, 12 inches.
Offset of eccentric rod pins, 3 inches.
Travel of valve, 5½ inches.
Lap ⅞ inch.

RESULTS FROM ACTUAL ENGINES.

The adjustment of the saddle stud is, of course, made for some one point of cut-off—usually at one-third stroke. To attempt to study the degree to which the various influences compensate one another at other points would lead us far afield, and the facts can be best seen by studying the results from actual engines. These are given in link charts Nos. 1 and 2, which are from eight-wheeled passenger engines and give a complete record of the right-hand side of two locomotives built by the Schenectady Locomotive Works. These charts are in no way exceptional, but are representative of what is done every day. The first two

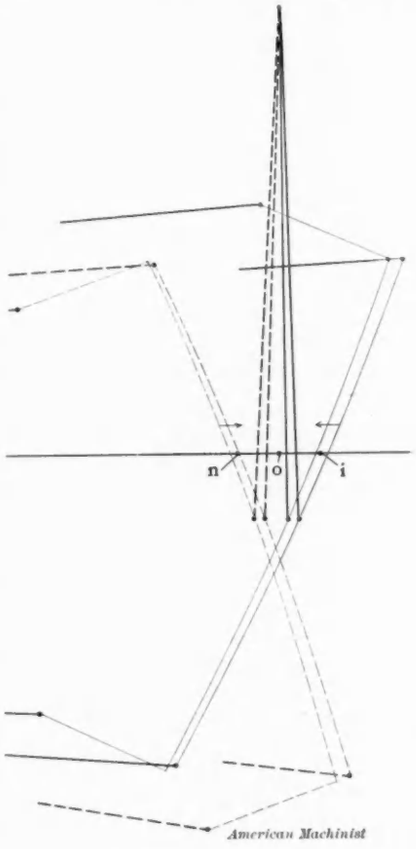


Fig. 24

THE ERROR DUE TO LOCATING ECCENTRIC-ROD PINS BACK OF LINK ARC.

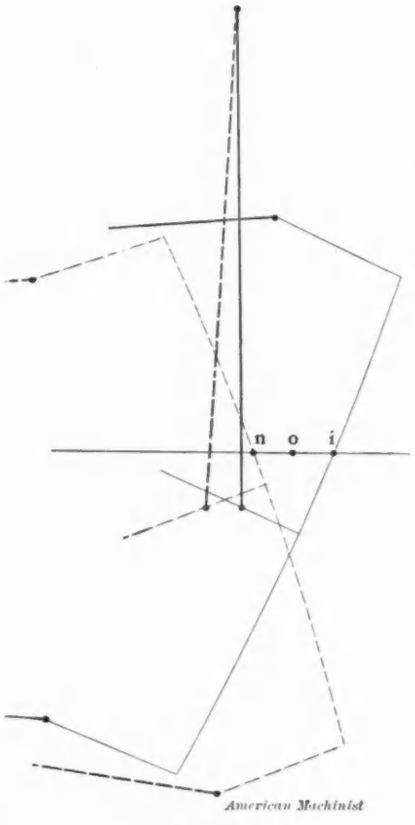


Fig. 25

CORRECTION OF ECCENTRIC-ROD PIN ERROR.

columns give the lead in the various gears, the second two columns give the port openings, from which the great reduction in port opening in early gears will be seen. It should be mentioned, to avoid misunderstanding, that the port opening given in the full gear, means the distance by which the valve uncovers the outer edge of the port. In locomotive practice this exceeds the actual width of the port, this excess of travel being given in order to obtain more port opening in the early gears. It will be seen that the equality of the cut-offs obtained is excellent, there being no appreciable difference up to the half stroke in chart No. 1,

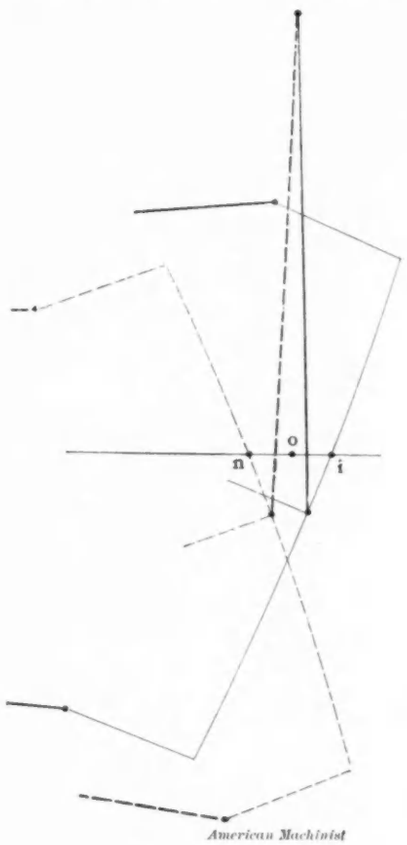


Fig. 26

STUD BROUGHT OVER LINK ARC BY SHORTENING CONNECTING ROD.

while the largest difference in the entire range is only 5-16 inch, which is found in the full gear. In chart No. 2 the action is not quite so good in the early gears, but it is still better in the late ones. This surprisingly good adjustment shows that nothing of consequence is sacrificed by neglecting the location of the reverse shaft as has already been described.

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We have previously referred to the record of one of the summer trains running between Camden and Atlantic City, and we are informed that this train, on July 17th, ran between Egg Harbor and the Meadow tower, a distance of 16 miles, in ten minutes, which is at the rate of 96 miles an hour.

A Modern Foundry.

A representative of the "American Machinist" recently had the pleasure of a walk through the Worthington foundry, at Elizabethport, N. J., under the personal guidance of Mr. Prince, the superintendent. The foundry, as most of our readers know, is a part of the world-famed pump works of Henry R. Worthington, the castings made here being shipped to the shops in Brooklyn, N. Y., to be worked up and distributed from there. The foundry is a large one, about 500 men being employed there. The class of work is among the most difficult that the molder encounters. Modern facilities and improvements have been quite generally adopted; an elaborate and effective system of management, supervision and record is maintained. Mr. Prince is an enthusiast in his calling, with wide experience, positive convictions as to what is best in present practice, large ideas as to the future of the molder's art, and is free and prolific also in suggestion as to the means by which, and the direction in which great advances are to occur, so that, to the writer, the occasion was not one of everyday occurrence. We can give only a few casual notes of what most particularly attracted both eye and ear, but trust that they cannot fail to be of some interest to our readers.

The patterns for the foundry, the wooden patterns, are of course all made on the spot, the force employed varying from thirty to fifty men. The pump business, we all understand, is a standard one, and the manufacture consists largely of the duplication of established styles, so that at first it might be thought that little new work would be called for, and improvements and consequent changes would be few, and new patterns would be infrequently demanded. The machine tool builders, especially, have been disposed to put on airs over the conviction that improvements have been their peculiar province, that they especially have done more than any others for the advance-

LINK CHART NO. 1.

Schenectady Locomotive Works.

Schenectady, N. Y., Feb. 21, 1895.

Built for St. Lawrence & Adirondack R.R. Engine No. 4437. Size of cylinders, 18" x 24". Size of driving wheels, 67".

LEAD.		VALVE OPENS.		CUT OFF		REMARKS.
Forward Stroke.	Rearward Stroke.	Forward Stroke.	Rearward Stroke.	Forward Stroke.	Rearward Stroke.	
1/16"	1/16"	1 7/8"	1 7/8"	21"	21 5/16"	Offset 7/8".
3/32"	3/32"	1 9/16"	1 9/16"	20"	20 1/4"	Slip 1".
1/8"	1/8"	7/8"	7/8"	18"	18 3/16"	
3/16"	3/16"	13/16"	13/16"	16"	16 3/16"	
7/32"	7/32"	5/8"	5/8"	14"	14 1/16"	
1/4"	1/4"	1/2"	1/2"	12"	12"	Slip 3/4".
1/4" F.	1/4" F.	7/16"	7/16"	10"	10"	
9/32"	9/32"	3/8" S.	3/8" S.	8"	8"	
9/32"	9/32"	5/16"	5/16"	6"	6"	

Passenger service, four coupled wheels. Radius of link, 60".
Length of main rods, 98 1/2". Lap, 7/8".
Travel, 5 1/2".

LINK CHART NO 2.

Schenectady Locomotive Works.

Schenectady, N. Y., June 1, 1896.

Built for New York, New Haven & Hartford R.R. Engine No. 4442. Size of cylinders, 20" x 24". Size of driving wheels, 73".

LEAD.		VALVE OPENS.		CUT OFF.		REMARKS.
Forward Stroke.	Rearward Stroke.	Forward stroke.	Rearward Stroke	Forward troke.	Rearward Stroke.	
1/16"	1/16"	1 15/16"	1 15/16"	20 5/16"	20 1/2"	Slip 1 1/4".
3/32" S.	3/32" S.	1 13/16"	1 13/16"	20"	20 3/16"	
1/8"	1/8"	1 1/4"	1 1/4"	18"	18 1/8"	
5/32"	5/32"	15/16"	15/16"	16"	16 1/16"	
3/16" S.	3/16" S.	11/16"	11/16"	14"	14"	
3/16" F.	3/16" F.	9/16"	9/16"	12"	11 13/16"	Slip 1 3/8".
7/32" S.	7/32" S.	15/32" S.	15/32" S.	10"	9 7/8"	
7/32" F.	7/32" F.	3/8"	3/8"	8"	7 15/16"	
		5/16"	5/16"	6"	6"	

Passenger service, four coupled wheels. Radius of link, 60 1/2".
Length of main rods, 94". Lap, 1 1/8".
Travel, 6".

ment of methods and the cheapening of production. We do not wish to dispute any of that; but, after all, something of the same kind of progress has been going on simultaneously in every other business. We are assured that, in order to keep up with the times and to meet all the suggestions of improvement and the demands of customers, the pumps in use have to be improved as persistently as any other machinery or machine tools, so that the pattern-makers all along have been proportionately as busy in the pump works as anywhere else.

The stock of patterns is, of course, a very large one, and a separate and isolated house is provided for their storage, with a complete record by division, section and shelf, and pattern designation and number of the location of every pattern. Five men are constantly employed in the storage and conveyance of the patterns to and from the various foundry departments. The order for any casting, or any lot of castings, has attached to it a series of coupons, which are successively torn off, dated and signed, and turned into the office as the different steps are accomplished in the progress of the order through the works. The office records will thus show, and the superintendent can instantly see, at any time when the pattern was delivered to the foundry, when the cores were delivered, when the molder got the order, and so on.

Many patterns are changed at different times and for various reasons. The record of these changes is kept in the drafting room. When the original designation number of a pattern is once established, the changes on it are designated by successive letters of the alphabet. If a pattern was originally "M. K. 17932," then "M. K. 17932A" would indicate the first change, and "M. K. 17932H" would indicate the eighth change which had been made upon it. The marks actually upon a pattern at any time always indicate what it is at that time, whether changed or not. We saw a pattern just going to the foundry with the "H" change on it to fill some repair order.

The power-house of the establishment has the modern characteristic of containing a variety of engines for various purposes, instead of the single long stroke, deliberate moving old-timer. In this establishment electricity and compressed air work side by side, each employed at what it can do best. Electricity lights the establishment and drives the traveling and other heavy cranes where the larger work is made. Compressed air is also carried all through the works for vertical direct-acting hoists wherever they are required, and also for the numerous molding machines employed. In the power-house, therefore, we find, first of all, a horizontal high-speed engine and an independent Worthington condenser which takes care of all the exhausts. Then there is the air compressor, and as this establishment very properly thoroughly believes in itself, this is, of course, a Worthington compound duplex pump, which may not, after all, be the best air compressor in existence. Then there are two engines driving the dynamos and engines for the three fan blowers for the three cupolas, which, we are assured, are a relic of the Dark Ages, and their presence is a reproach to any modern plant. They give absolutely no guarantee as to the volume of air delivered. It all depends upon the freedom of the tuyeres and air passages, and if these become choked, as they often do, the fan blower tamely accepts the situation, while a positive pressure blower would insist upon its rights every time. Besides all these, there are one or two water pumps, although, rather strangely, water is not as much in evidence in this establishment as might be expected.

Of the foundry as a whole, the distinguishing feature, as compared with the average foundry, is in the general use of the molding machine. It is here used for practically all the standard work of the concern, and up to sizes weighing more than half a ton each. The molding machine is here probably to be seen at its best, both as to opportunity and as to performance. While it is at once a great saver in labor cost, and while it secures more excellent and uniform work than is possible with unaided hand labor, the cost of installation must deter any small concern from going into the system very deeply.

For small work, such as, for instance, much of the bronze or composition castings, hand-operated machines, designed and made at the works, are employed. In these the sand is rammed or pressed by a pull on a simple lever. One or two Tabor machines are also in use; but the chief machine employed is the Indianapolis machine, whose general features are sufficiently well known to the trade. These machines are employed on work of considerable size and weight, so that the flasks are handled by pneumatic hoists which come right over the flask on the machine, pick it up, run it off by an overhead trolley and set it down on the floor. The machines are duplex, and make cope and nowel alternately. For each machine a circular pit is built, and the machine is sunk sufficiently to bring the top of the flask to a comfortable hight for the men. One half of a flask will be set on the pattern plate, the sand shoveled in and the pressure applied; this being equalized by rubber bags filled with water. Then the sand is struck off, the pattern is drawn down out of the mold by the movement of a lever, the same movement throwing up the pattern in the opposite plate. The flask is lifted off by the air hoist and run off to the floor. The other plate with the other half of the pattern is then brought around, and the operation goes on. These molds, before closing, have usually a lot of intricate cores set in them. Each machine is usually operated by three men; two at the machine itself, and the other at the hoisting and conveying; and we were shown double-pump cylinders of which the three men would turn out thirty per day. The machines of this class employed here, with the immense stock of carefully fitted metal patterns which are stored in an isolated house of their own, may have cost nearly $100,000, so that such a system is not for everyone to think of adopting.

It is easy to understand that, for a pump works making the complicated castings required in the modern designs, the core department rises to unusual importance, and it has therefore here received unusual attention. The core-shop building is new, large and well lighted, with a steel truss roof and wide galleries on each side, devoted mostly to the storage of finished cores. The usual practice of foundries in making cores has been to live from hand to mouth, to make each day, or the day before, the cores as they might be required. In this establishment the cores are made up in large quantities, and are stored often for six months ahead.

A change seems to be in progress in foundries, as o the material of which cores are made. Sand is, of course, still the basis; but the material by which the sand is bound together has been the subject of wide experiment. The objection to all of the binding material, as a class, is that it is easily combustible matter, and that when exposed to the heat of the iron it generates gases which it is difficult to get rid of, and which often cause blowholes or other flaws in the castings. Other things being equal, the material which will generate the least gas may therefore be presumed to be the best. The most universally used material is wheat flour. Linseed and other oils have more recently been tried, and some parties speak favorably of the results, while others do not favor it. There is said to be somewhat less gas generated, but the cores are not at first so strong, and must be handled with great care in the earlier stages. A more promising material in extensive use here is "jelulose." The principal advantage which it seems to possess over flour is that a considerable less quantity is required. "Jelulose" seems to be composed of the gluten of the wheat without the starch. In core making here flour is used in the proportion of about 12 to 1, while the "jelulose" is only required 30 to 1, a saving of 60 per cent. in the objectionable gas-making material. A little experience is required in the use of the "jelulose," especially as to the baking of the cores. They should not in fact be baked, and require little more than careful, slow drying. They can be placed in the sun and dried sufficiently for use. The cores are strong and durable. We were shown some which had been standing for months and were hard and strong. The cores are more subject to atmospheric changes, and collect the humidity,

when standing, more copiously than the common flour-made core.

As many very complicated cores are used for the intricate valve chambers and water passages, cast-iron skeletons of curious outlines are largely employed. These are cast in open beds in the foundry, and are stored, like everything else, in considerable quantities. They usually cannot be removed entire from the castings, but have to be broken up, so that new ones are constantly required. Wires, straight and bent, are of course also largely employed, as elsewhere; but these also are stocked systematically, and are never gotten out as an emergent requirement. The extent to which the piece-work system is employed may be understood from the fact that even the straightening of the core wires is done by the piece.

Cleaning the castings is still mostly hand work. Tumblers are used for work as heavy, sometimes, as half a ton, and for quite heavy pieces generally, and they come out in excellent condition. The tumbling effect is considered more valuable and important in cleaning out the ports and intricate and inaccessible portions than for the outside. Both the sand blast for cleaning castings and pneumatic chipping tools have been tried here, but have not found favor.

There has been, as we all know, a great general advance in foundry practice in the last quarter of a century. There are, however, numerous and great opportunities in sight for still more radical improvements. It is not to be wondered at, but rather a perfectly natural thing, that those to-day representing or associated with the most enlightened practice and who are accomplishing the best results, should see ahead of them the widest field of opportunity. Our practice in handling sand is still of the crudest. Why should not the molding floor, or the neighborhood of the molding machine, be always ready for molding? Why should not the sand be shaken out elsewhere and tempered and stored all together, and conveyed by travelers and chutes just where it is wanted and be drawn just as it is wanted? Why should there be such an enormous waste of sand, and why should it be necessary to continually throw it away? There is reason for throwing away the ashes from burnt-out coal, but with foundry sand the case is reversed. The sand is what we want, and only an essential element of it has been destroyed or removed, and this it should be possible to replace, and so restore the sand to its original condition, instead of throwing away the whole. It is not at all impossible that our cupola practice is altogether wrong. The first cupola was vertical, and every succeeding cupola has therefore been vertical. It can scarcely be said than any other form has ever been fairly tried. The flames from the cupola top show plainly enough that something is radically wrong in our melting methods. Heat costs money, and yet we allow it to escape us. These are only simple suggestions of an hour, which it is perhaps neither necessary nor profitable to follow further here.

▲ ▲ ▲

A New Tap and Die.

The cuts shown serve to illustrate a system of tap and die manufacture differing somewhat from the common practice. The essential idea embodied will be understood upon reference to Fig. 1, which shows a tap made for parallel through holes. The shank may, of course, be of any length necessary for the special line of work upon which it may be employed. The thread of the tap is first cut practically parallel, or so that the bottoms of the threads are of the same diameter for the entire length. The tops of the threads are then successively flatted off into a number of parallel steps. In the tap as shown there are four such steps, the first step being 7 threads, and each of the others 6 threads. The result of this arrangement is that the first thread of each step does the most of the cutting. It is claimed for the tap that it cuts the pitch of the thread more accurately than the common tap with the long straight taper to the tops of the threads, that it requires less power to drive the tap, that the tap maintains its size better, and that it wears slowly. The threads are cut with a proper backward clearance, as usual. The first cutting tooth removes the metal for the full width of the thread and does the heaviest cutting. Each subsequent cut removes less and less, leaving only light work for the finishing. The flat or parallel tops to the threads are thought to offer less resistance to the feed of the tap longitudinally than is experienced with the taper or wedging tops of the common taps.

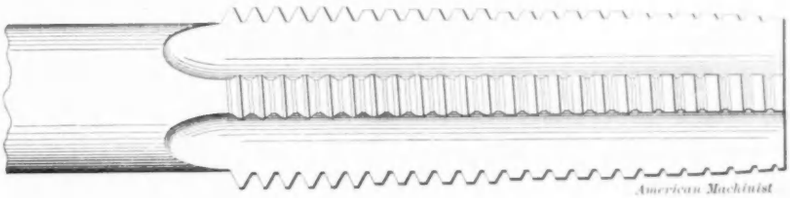


Fig. 1

A PARALLEL THREAD TAP.

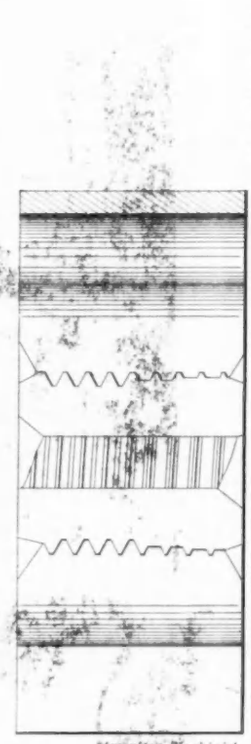


Fig. 2

BOLT DIE.

Fig. 3

PIPE DIE.

The die, shown in Fig. 2, has been worked out as a companion to the tap, and embodies the same idea. The essential features are the same, and the inner diameter of the die has been increased by a number of parallel steps forming flat top cutting teeth which remove the metal in the same manner as the tap.

The taps and dies described have been used in a number of establishments and have received high endorsement. The writer has examined a bar of machinery steel nearly 12 inches long which had been tapped lengthwise ¾-inch standard thread, and into and through this was screwed a rod cut with one of the dies, showing a good fit and almost absolute identity of pitch. A chip shown from one of these dies is as cleanly cut as ever seen from a lathe tool, a perfect helix 7 or 8 inches long, ⅜ inch pitch, and about ½ inch external diameter. The chips cut by the tap, although broken up, also show clean, heavy cutting. They give the impression of having been actually cut, and not rubbed or pushed off.

Fig. 3 shows a pipe die. As is well known, this form of die is made to cut a taper thread, and the bottom lines of the teeth in the die cannot be made parallel, but it has been found that the same form of teeth applied to this die has wonderfully increased its cutting power, and the shape of the teeth when finished is found peculiarly favorable for insuring tight joints. Referring to Fig. 4, it will be seen that when the taper threads have entered nearly to their limit, the sharp top of each female thread first comes in

contact with the flat bottom of an uncompleted male thread, and as the threads are forced home the sharp tops of the threads bite into the bottoms of the flat grooves and form a perfect metal contact, ensuring a tight joint. It has been found that these dies cut steel pipe with great ease, while with the common dies it is a difficult thing to do.

The taps and dies as described are made by Charles Elterich, Worth street, New York. It may be that the results achieved by these tools are not all attributable to the features to which we have called attention. The experience gained in years devoted to this line of manufacture should count in every detail and produce the best possible combination of desirable features.

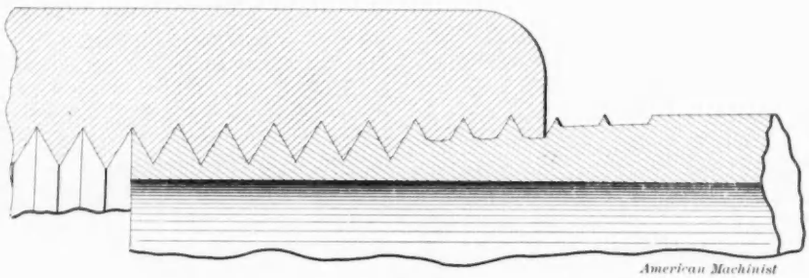


Fig. 4

PIPE END AND COUPLING.

Radial Driller.

The accompanying illustrations are of a new radial driller possessing some features of interest. As will be seen, the arm is fitted to flat surfaces upon the column, the latter being in two parts, which are fitted together as shown in Fig. 2, by which it will be seen that the weight of the column is carried upon balls, and also that there is a new method of clamping the upper column to the lower or "stump." To effect this clamping that portion of the column which enters the stump is slotted open as indicated, and a toggle joint is so arranged as to expand the column and thus clamp it within the stump. The arrangement of the toggle joint will be readily understood from the sectional view, Fig. 2. It is operated by the lever seen at the side of the column in the photograph, which lever is attached to a shaft having an eccentric formed upon it. All the internal mechanism is, of course, so arranged that the vertical driving shaft can pass through it in the center of the column.

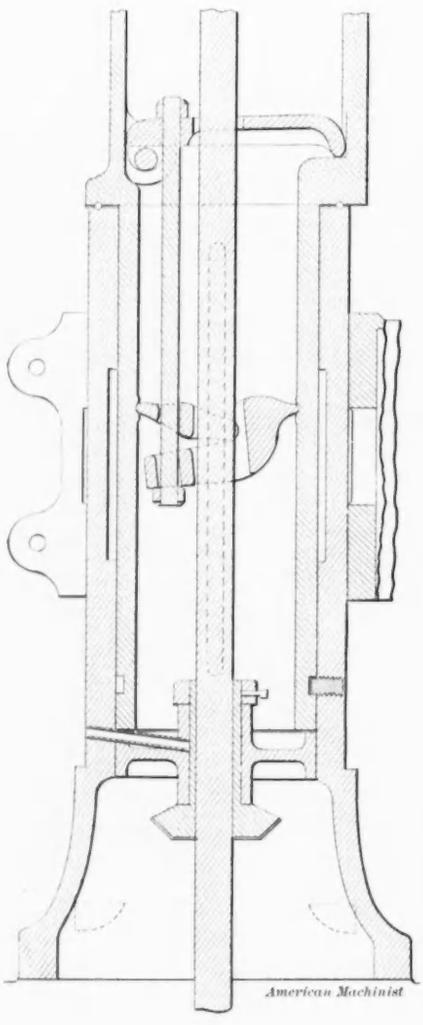
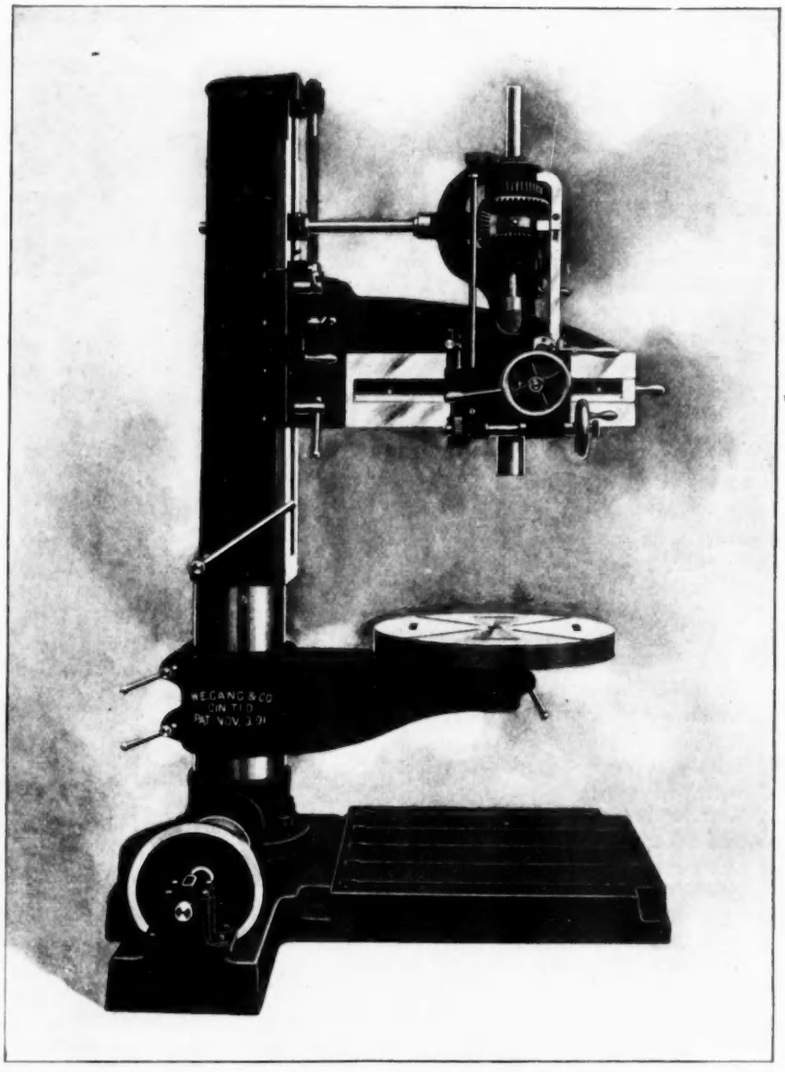


Fig. 2

SECTION OF RADIAL DRILLER.



NEW RADIAL DRILLER.

The arm is moved vertically upon the column by power, a stationary screw being employed for this purpose, and the nut is rotated in either direction by gears driven from the central vertical shaft and thrown in or out of engagement by the short horizontal lever attached to the arm near the column.

The back gears are applied directly to the spindle, and by means of the double end clutch seen between the two bevel gears the spindle can be started, stopped or reversed without altering the motion of the rest of the machine. The back gear need never be disengaged, as they are idlers when running the spindle out of gear, and the same lever effects all these changes.

Three changes of feed are given by cone gears and sliding key, this key being moved or locked in position by the small lever shown at the left of the head.

The table on the swinging arm is added to facilitate the lighter work sometimes desirable to be done upon such a machine. It is moved vertically by rack and pinion and can be swung around the column out of the way when not in use.

The machine is designed to drill to the center of a 66-inch circle. It is made by William E. Gang & Co., Cincinnati, Ohio.

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Letters from Practical Men.

Throwing Out the Nut and Catching the Thread on the Engine Lathe.

Editor American Machinist:

Will you or Mr. Tecumseh Swift kindly tell me how, in cutting long screws, to run the carriage back to the beginning and strike the thread again when the lead screw is not the same pitch as the screw which is being cut? I have no doubt it can be done, but I can't do it at present, and I want to learn how. C. J. D.

It certainly can be done, and is now done so generally that the not doing it provokes remark, and it is not to be wondered at that Mr. Tecumseh Swift spoke of it when he saw it. How to do it has been shown up very thoroughly in earlier volumes of the "American Machinist," but not much has been said about it for a few years past, as it has not seemed to be necessary; but it may be proper for us now to tell it again for the generation of readers represented by our esteemed correspondent whose note appears above.

As our correspondent already understands that if the thread to be cut is the same pitch as the lead screw of the lathe, the nut can be thrown in on any thread of the screw without stopping the lathe, and the tool will always come right, that fact will give us a very good starting point. We can say next, that if the thread to be cut is any multiple of the thread of the lead screw, then also the nut may be thrown in anywhere. Thus if the lead screw is 5 to the inch, then the nut can be thrown in without stopping the lathe, or without any precautions when cutting 5, 10, 15, 20 or 25 threads, and so on. So if the lead screw is 4 to the inch, the nut may be thrown in indiscriminately when cutting 4, 8, 12, 16, 20 or 24 threads, or any higher multiple of 4.

For the case which generally occurs of cutting any whole number of threads to the inch, assuming that the lead screw also has a whole number of threads to the inch, which is usually the case, the simplest way to do, after once closing the nut on the lead screw and getting the tool all ready for work, is to stop the lathe dead still, throw out the nut, move the rest along an inch, or any exact number of inches that may be required, and then close the nut again before the spindle is allowed to turn. That really covers the whole case; the lathe may be stopped anywhere, with the tool at the end of the cut or halfway or anywhere else, and if the spindle is stopped before the nut is thrown out, and not turned at all until the nut is thrown in again, the rest may be moved either to the right or to the left any number of exact inches, and the nut may then be closed again, and the tool is bound to come right. If the lead screw has an even number of threads to the inch, and if the number of threads to be cut is also an even number, then the rest may be moved any number of half inches, and when the nut is closed the tool will follow the thread all right. All the above applies as well for left-hand screws as for right-hand screws.

When it comes to measuring off the inches it will depend upon circumstances about what arrangement is best to be employed. A rule or a steel scale may be laid down on the lathe shears so that one of the inch marks will just come to the end of the rest, and then the rest may be moved back until the end of the rest comes opposite another of the inch marks and then the nut may be thrown in. The rule should, of course, be secured by a weight or clamp, so that it will not slide. Some lathes have the apron gearing so arranged that each revolution of the handle moves the rest along exactly an inch. In such a case, when the lathe is stopped, it is only necessary to notice the position of the handle or crank when the nut is opened, turn the crank to the same position every time and then close the nut. When cutting a lot of screws of the same length and with the thread ending at the same place it will not be necessary to measure the distance every time. If the spindle is stopped every time at the same position, when the distance is once measured, it may be marked by chalk or otherwise, and the measuring may be dispensed with after that.

Fractional threads will, of course, not catch right on the exact inch. If the fraction is ½, as 4½ or 11½ to the inch, then the rest must be moved two inches at a time, or any even number of inches, to have the nut thrown in. If the fraction is ⅓, as 2⅓, 3⅓, etc., then the interval must be three inches and so on. The writer once had a lot of cast iron jackscrews to cut, five inches diameter, and about four feet long, square thread. They went to China, by the way. The pitch was ¾ inch, or 1⅓ threads to the inch. According to the above the rest should have been moved some multiple of 3 inches to catch the thread all right. As the lead screw was 4 to the inch, three threads would, of course, be ¾ inches, or the same as the pitch of the screw to be cut, so that the nut could be thrown in correctly at every third thread of the lead screw. In cutting those screws the hand gearing for moving the rest along was dropped out of gear. After the tool got to cutting all right the lathe was not stopped. When the tool got to the end of the cut it was drawn out as quick as possible and the nut was unclosed. The rest was pulled or shoved back to the other end, and the time to throw in the nut was determined by watching the big thread on the work in the lathe as it came around. There was no trouble in throwing in the tool all right every time. All that was considerably more than a score of years ago, so that the use of the backing belt for screw cutting is, as a general practice, rather behind the times; though, of course, it pays to use it for such short and small screws as make the backing operation quicker than opening the nut and running back by hand.

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The Record Pumping Engine.

Editor American Machinist:

In the "Questions and Answers" column of the "American Machinist," September 16th, you give the duty of the Milwaukee Pumping Engine as 143,306,000 foot-pounds per 100 pounds of coal. By referring to the Report of the Duty Test of this engine (Trans. A. S. M. E.) you will find that this duty is based on dry coal.

I enclose copy of duty test of the triple expansion pumping engine at the low-service pumping station of the Brookline, Mass., Water Works. This engine gave a duty of 140,113,000 foot-pounds per 100 pounds wet coal. As there was 2.77 per cent. moisture in the coal the duty of this engine on the same basis as the Milwaukee engine, viz., 100 pounds dry coal, would be over 144,000,000, consequently the Brookline engine holds the record.

RICHARD J. FLINN.

West Roxbury, Mass.

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"The Draftsman and the Shop."

Editor American Machinist:

I have read with great pleasure and considerable amusement the letter of your correspondent, "Draftsman," in the last issue of the "American Machinist," and I think all will agree with me in admiring

the exhaustive way in which he has handled his subject. Yet in enumerating the qualifications necessary to a successful draftsman, a grave omission has been made, namely, that he be a first-class amateur photographer—this will greatly assist in raising him in the estimation of his bookkeeper and office boy.

ANOTHER DRAFTSMAN.

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Arithmetic in the Shop.

Editor American Machinist:

As you seem to be quite disposed to help a fellow along when you can, and as you have already helped me considerably on a good many points, I have been thinking that you might perhaps help me a little more, and some other of your readers at the same time. I have been working in a steam engine and general machine shop for two or three years, and I have caught on to a great many things connected with the trade. I find that there is considerable more to it than just running a lathe or a planer and seeing a few chips made every day. I have some hopes of getting along, and of being somebody and doing something. I find that in planning and managing things there is a great deal of figuring to be done, and that is a thing that I need to polish up in. Could you give me a few hints about the best way to get to be expert at arithmetic—not the arithmetic of bankers and life-insurance sharps, but the arithmetic that would be handy for a fellow running the common tools of the shop, with a hope of some day getting to be a foreman, or maybe undertaking something on his own hook? If you could do something for me in this line, I would be very apt to appreciate it, and try to benefit by it. G. T. C.

Certainly we will try to do what we can to help our friend along. We regard arithmetic as one of the most necessary tools of a fully equipped and up-to-date machinist. But we do not furnish tools, and we do not propose to inthis case. As the two-foot rule is to be got at the hardware store, so the best place for getting an arithmetical equipment is in the common school. We do not think that the boy that is brought to the shop to learn the trade because he will not learn anything in school is the most promising material out of which to make a good machinist. That objection is not always fatal, however, because it often happens to be the fact that at school the boy's interest has not been properly awakened, and he has simply not taken hold of things, while as soon as he gets into the shop his entire attitude changes. When he gets a chance to actually do things, a healthy minded fellow wants to do as much and to do it as well as anybody else, or a little better. When a fellow of this kind gets under proper headway in the shop, he begins to find out that he has missed it in not being more diligent at school. The loss, when a fellow gets to that point, is, as far as shop arithmetic is concerned, not as serious as it looks, and it is easily cured. There are, after all, not many that get into the shop who have not acquired some knowledge of the four principal operations of the arithmetic—addition, subtraction, multiplication and division. Well, when they have those they have really all the essential tools required in arithmetical operations. In the shop we put metal together by casting or forging, or sometimes by bolting or riveting, and we take off portions of metal in chips, or have other means of separation, and these operations cover practically all the operations of the trade. So in arithmetic our work consists of putting together or taking apart; addition and subtraction are the retail operations, while in multiplication and division we do them by wholesale.

While we say, very properly, that we do not furnish machinist tools, we do have something to say about how to use the tools so as to produce the best results, or to do the best work, and there is no reason why we should not tell; or, rather, there is reason why we should tell, about the use of the tools of arithmetic as well as of other tools. We have always this duty in mind, and when computations occur, as they do frequently in articles which appear in our columns, we purposely make the arithmetical operations as clear as possible, and if they are not thoroughly intelligible to our readers, we are always glad to have our attention called to it.

There really at present seems to be but one item of advice that it is worth while to offer our correspondent, and that is, to give his arithmetic a fair chance. The one thing above all others to be said about the use of any of our tools is, that we must use them frequently, constantly and for a long time, and get quite used to the handling of them, before we can expect them to be of much service to us, or before we can do very expert work with them either in quantity or in quality. A man may have the best lot of calipers that ever were made, and yet he must use them every day for years before a master mechanic will trust him to make a press fit, for instance, with them. Lots of mistakes and failures are scattered all along the path of experience, and the experience ultimately gained would not be worth much without them. The hatful of eyes which the oculist must spoil before he becomes an expert does not represent labor thrown away. They are typical of the cost of skill everywhere.

The general truths regarding the use of tools are as applicable to arithmetic as anywhere. There is no use of tools wherein practice is more necessary. Many who lament that they are not arithmetical experts are simply spoiling for proper and sufficient use of it. A green bank clerk may lament that he cannot shoot up a column of figures like the bookkeeper; but work instead of lamentation, is what he needs. Our correspondent is all right, and we wish him all success. If he encounters any specific and insurmountable difficulties in his mechanical computations, we hope that he will communicate with us at once, and we will try to help him out; but we cannot, in the ordinary sense, undertake to teach arithmetic or other branches of learning that are already better taught by the text-books and teachers; particularly when, as is usually the case, what is needed is simply persistent practice, rather than instruction—same as with a file.

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The Place of Our Destination—XII.

COPYING MACHINE DESIGNS—SOME LATHE FEATURES—MACHINE TOOL IMPROVEMENTS SHOWN AT STOCKHOLM—HAND WHEELS—GOOD AND BAD AMERICAN TOOLS.

Editor American Machinist:

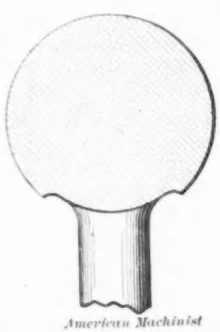
We American mechanics are a queer lot. All the while wondering why European mechanics do not do things as we do, and then when they do, we make a great row about their stealing our inventions and copying our designs. Mr. Hallstrom, of the Kopings Machine Works, who has one of the best machine tool exhibits in the Stockholm exhibition, looks at the matter in this way: Everybody has to do a great many things as other people have done them before. When a thing is done in a good way, he does not see why he should study out some other way to do it differently; at least it was Mr. Hallstrom or someone else who put it this way, and his machines show where things have been made right by other people, whether American or European, he does it that way too, and when he thinks he can do better he has done that. Take, for instance, his sixteen-inch lathe. It has a very familiar look, but the headstock does not rest on the VV's; they have been cut away so the headstock rests on the flat, and is adjustable sideways by headless set screws. If setting the headstock on the VV immovably is correct, why not cast it on and be done with it?. Because it is hard to make it true and keep it so; which is argument enough to convince Mr. Hallstrom and myself that the plan he has selected is right. He has not as yet, but proposes to introduce in the headstock the same changeable speed used in turret-head machines.

A little kink which I had not seen before is countersinking the tool-post wrench on each side to give additional guide in catching it on the screw. The slide rest has permanent shields to keep chips and dirt off the screw. Of course, we have all seen these, but usually it has been where one has "done it himself." His tail stock binding handle is on top, and the spindle binder goes down

through it. All handles are of horn or hard ruber, and turn free on the crank spindle; just a little better than our forged handles, and a great improvement is in the back gear arrangement. When the gear is thrown in, which is done by an eccentric shaft, as usual, the handle comes to a fixed position and a spring pin enters a hole and keeps it there.

If there is any one thing more trivial about our lathes than the little narrow cross slides it is the ridiculous little pin concealed within the eccentric shaft box to limit its throw. It never stops the gear in the right position but once, and never holds it there.

He uses an adjustable index on the cross-feed screw for screw cutting, which is really better than our usual screw stop. He shows two sizes of side planers such as he builds for Mr. George Richards, and they make the gib for the two sides



HAND WHEEL RIM.

of a square guide in one piece, which is as much better as it is more expensive, and the tool block of the machine, as well as of all their planing machines, is so designed that when the pressure comes on, it puts no strain on the pin, but wedges in and hooks under—in fact, it's a mechanical job.

A turret-head machine, somewhat like the Bullard machine, has a three-tool turret on the cross slide, besides the main turret, which has Richards' rotating device that works this way: As the handle which binds it is pushed back, it first releases it, then, pushing back further, allows a catch to engage so that as the handle is drawn forward, it rotates the turret to the next tool, and a still further pull binds it fast.

The turret is fed up by either a lever or screw, neither interfering with the other, and the turret is arranged to do taper work, which I have not seen before.

A large boring machine of the Bement type is nicely arranged for threading holes, and it is done in this way: A split taper sleeve is fitted to the boring bar, and around this sleeve are fitted bushes with different pitch threads cut on the outside. Either of these can be set anywhere on the bar, and a piece of a nut exactly as used on a Fox lathe completes the master screw feature. For a tool he has a cute device to withdraw it to run back and to set the cut.

The use for this device will become more apparent when one understands that the machine is a milling machine also, and has upon the table a second table, square and arranged to be fixed in two positions exactly at right angles with each other. Knowing the value of this feature by several years' experience with our transversing machine, which enables us to cut at right angles without moving the piece, I can readily believe that such a machine as Mr. Hallstrom shows must be kept constantly employed where in many shops, when the machine is a boring machine only it would lie idle quite a good part of the time. The machine, too, is arranged with index scales to set off distances. When one becomes accustomed to a machine that can face off work and bore or drill and tap holes without moving the piece or having to lay out the holes he begins to appreciate a machine of this character. Unlike the ordinary boring machine of this character the Koping's machine has automatic feeds in all directions.

There are various drilling machines—the upright, with a neater rig to change back gear than used in the Barns, if possible, and a radial on the Richards design, and in discussing the machine Mr. Hallstrom proposed the following improvement: One defect in all radial drilling machines is the springing of the post, allowing the arm to go up and cock the drill. Mr. Hallstrom's proposition is to shrink in a strut to put the post in greater tension on the drill table side than it will ever receive by the strain in use. This looks plausible on the face of it, but unless the strut is of something absolutely unyielding the thing will not work. The whole thing becomes a spring, and, according to the law governing springs from one pound load to two pounds it will go a certain distance and from 101 pounds to 102 pounds it will go the same. To do any good the strut must be of something less elastic than cast iron. Casting the column between chills would likely do more good than anything else. The post in this case has no machine work on it.

In making hand wheels unless one has a milling machine rigged to mill between the arms it is more or less of a job to dress them out with a file, and at the Koping Works they cast them as shown in the sketch Fig. 1, finishing only the circular part, painting the inside the same as the arms. This is half a good plan, but it is necessary to follow the correct method to get it to look well, and when the correct method is followed there is but little filing to do to make a finished rim. First set the hand wheel true by the inside and sidewise by the outer end of the arms, bore and put on a mandrel, turn both sides until they just hold up. Set caliper to thickness and turn the outside down until the caliper will about go over the rim from outside to in, then when the rim is rounded up there is very little filing to do.

To a great many of the readers of the "American Machinist" this will seem a foolish story to tell over, but when one notes the number of finished hand wheels he finds with an $\frac{1}{8}$-inch rib between the arms and remembers that there are hundreds of young readers of the "American Machinist," the explanation is justifiable.

The Koping cutter, reamer and tool grinder, of which you gave cuts and description is, I believe, as much in advance of our practice as anything we have is ahead of any foreign practice, and yet its merits are entirely ignored as a general thing in our country. The nature of the thing is to grind all cutters to perfect shape by a template after the cutter is hardened, and is exactly what we do with all straight cutters and would never think of using them any other way, but cutters made to shape are hardened and sharpened by grinding the face. I have known this grinding cutters by template to be done in gun work, and fits obtained that could be done in no other way, but the regular American tool room cutter grinder is certainly not constructed on this simple and accurate principle. Among other of the exhibits from the Koping works is a tool room milling machine on the general principle of the B. & S. Lipe machine with some modifications that make it the most complete machine of the kind I have seen. The accuracy of the working parts equals the best and the finish is only surpassed by the best French work.

In talking with Mr. Hallstrom about American machine tools, he gave a bit of his experience. He ordered of two well-advertised American builders one each of their lathes; both were fairly well finished outside, and one was equally well made in its working parts, while the other was rotten—simply shoddy. As the concern which built this last mentioned lathe is said to be selling vast quantities of machinery, and very little in Europe, and as the best of our Eastern builders are selling the bulk of their product here, the question arises, How long will it take to so saturate the European workshops with our best and dilute our own shops with the poor, that we shall be put in the second place? if, on the whole, we now have first.

I have given more space to this exhibit than its size would justify, because Mr. Hallstrom speaks English, and it was easy to go into details. At times we have been days without anyone to talk to but ourselves, and when we heard a fellow early one morning whistling "Long, Long Ago," in English, it was a treat.

JOHN E. SWEET.

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"Them electrical fellers is goin' ter make us work fer 'em," bubbled the Water Fall to the Brook. "Well, I'll be dammed!" babbled the Brook.—"Electrical Review."

AMERICAN MACHINIST

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John A. Hill, President and Treasurer.
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Fred J. Miller, Chief.
Frank Richards, F. A. Halsey, Edward P. Buffet, Associate Editors.

▲ ▲ ▲

Illustration Department.
A. L. Donnell, Chief.

▲ ▲ ▲

Advertising Department.
C. P. Day, Eastern Representative.
J. M. Wakeman, Western Representative.

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British Representative.
R. E. Howard, 9 Leonard St., Finsbury, London, E. C.

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We invite correspondence on subjects pertaining to machinery.

Name and address must always be given, though not necessarily published.

Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.

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Switching Back.

It is so easy to get in a bad way. There are so many bad ways; none of them have gates, and they slant off at easy angles, so that if one doesn't look out he is traveling full speed for the bad instead of the good before he knows it. Shops get in bad ways, and especially so in bad times; but when the better times are at hand the bad ways do not right themselves.

This may be more or less a funeral sermon, or an attempt to enforce a lesson after the fact, a kind of discourse we seldom indulge in, for the reason that it does so little good. If the bad times are dead or dying, we have only to drop them and all their evil associations with them. The curse of slack times is that we lose headway and momentum all around. We get an idea that it is of no use to hurry any more, so we take it easy. The employer thinks that it will be waste of labor to look for orders in such times, so that he doesn't push at that end. He wants to keep his best hands along so that he will have them when business picks up, so he doesn't push them. The men see little or nothing ahead and don't want to work themselves out of a job, so they don't push things at their end, and so it goes. This is surely a bad way, and it is a way to get out of as soon as possible, and perhaps no better time ever existed for a general bracing up than just the present.

We are not adepts at perfunctory booming, and have little faith in the results produced by such means. We cannot, however, shut our eyes to the signs of the times. To-day there is much business being done, even in machinery lines, and there is going to be much more. What business is being done the hustlers are getting and the hustlers are doing. The continually prosperous business is not vigorous in spots, but has life and health all through it. Some have an idea that hustle works like a see-saw. When work is slack in the shop the office force and the men on the road must hustle, and when business is brisk the shop force must hustle while the drummers take a rest. That is see-saw, and see-saw is not business. A teetering business so easily becomes a tottering business, and we have known concerns to tumble over after the fashion here suggested.

If the slack times have had their demoralizing effects upon us it will be well to shake them off as soon as possible. Now is the time to put on a little more pressure, to increase our speed, and to see that a speed as nearly uniform as possible is maintained.

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The Automatic Mechanic.

The power of automatic machinery is spread over all the earth, and the products of it also are everywhere. No man can say how great and beneficent has been, and still is, its mission. The singing of praises might, however, cease for a while, and a more needed word might be said for the automatic mechanic. It may appear that in the man as in the machine the automatic action is the crowning excellence and the supreme agency of achievement.

Men, like machines, are some of them self-acting, while most of them are not, and the difference is great. It is as great as, and strikingly similar to, the difference between the locomotive and the freight car. One is drawn entirely by an external force, the other is not only self-propelled, but draws a long train after it. The mode in which the driving force is developed and applied to the individual movements of man has as wide a range as in the machines which he builds. We may go right into the shop and note the phenomena. Any man that works in the shops is very sure to learn the use of the two-foot rule, square, calipers, surface gage and such things to a certain extent, because if he does not he will lose his job, and he is under the necessity of earning his living. The driving force in the development of his skill up to this point may be said to be chiefly outside of himself. Circumstances and the shop foreman develop a necessary amount of skill in the use of tools, and their power stops there. When it comes to the higher operations and qualifications the driving is not so directly from without. The higher the man gets the more automatic or self-acting he must necessarily become, and, conversely, the automatic and self-impelling principle always drives upward and never downward. The apprentice and the man must chiefly drive himself into habits of forethought, thoroughness and general reliability if he is ever to develop them. He must drive himself into the exercise and growth of the exalted and exceptional skill which the expert must possess, or he must remain the mere operative. No foreman and no proprietor will set an apprentice or a common man of the shop to the task of computing the strength of structures, the sizes of pulleys or gears for different speeds, to the sketching of machinery or the invention of novel and useful devices, although they will readily avail themselves of the ability to do such things if they find it ready to their hands. Opportunity is never opportunity to the unprepared.

In another column we have an inquiry from a young man on the general use of arithmetic in the shop. There will be no trouble about his arithmetic if he is possessed of the true automatic attachment, and we are confident that he has it. If he trusts to some external force to drive or drag him all the way he will never get there.

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The practice adopted by the French Navy for the preservation of boilers not in use is different from that generally in vogue, and it is worth at least making a note of. They seem to take the bull by the horns. Instead of emptying the boiler, they fill it completely full of fresh water, and then add to the water a certain amount of milk of lime or soda. The solution used is not so strong for boilers with small tubes; it is intended to be just sufficient to neutralize any acidity of the water. Particular attention is given to the outsides of the tubes, if they are not to be used for a long time. They are painted with red lead or coal tar as far as they are accessible, and for the rest a protective coating is obtained by burning tar, the smoke of which will form a coating of soot. Besides this, the boiler casing is closed and kept air-tight, after some quicklime has been placed inside.

The Engine Room of the Kaiser Wilhelm der Grosse.

By the courtesy of the Blake Manufacturing Company a representative of the "American Machinist" was one of a party who, on the day before starting upon her return voyage, were permitted to visit the engine room of the Kaiser Wilhelm der Grosse, the latest, largest, swiftest and most costly of the ocean racers. The party was personally conducted by Mr. F. M. Wheeler, who has a special "pull" with the North German Lloyd Company, from the fact that the Wheeler independent air pumps, made by the Blake Company, are installed upon this ship, and have contributed their share to her success. The ship also carries auxiliary feed, fire, bilge and water service pumps—eleven in all—made by the same company.

Our visit was timed to occur at the noon hour, when the crew were at dinner, and when no other visitors were aboard; so that, for the short time that could be allowed, the most absolute freedom of access to every part of the engine room and stoke hold was allowed. The engine rooms are entered from the main deck, which brings the tops of the cylinders, the high-pressure cylinders forward and nearest the boilers, to about the hight of a man's shoulder. Besides the first platform there are two others surrounding the engines, and three successive ladders are descended to reach the level of the crank shafts. Here there is ample room to walk around. The engine rooms are quite light in the daytime without artificial lighting, although this is always ready. Here we can see the enormous cranks, which have big counterbalances on them; the connecting rods, eccentric rods and all that, and look up at the vast structure of ironwork towering above.

The main engines leave only a passageway between each and the central bulkhead, the air pumps and the great condenser for each engine being placed at the outboard side. Each entire thrust bearing is shown in the engine room proper, and opposite each are the centrifugal circulating pumps, driven by their own engines. A row of pumps for various uses stands along the forward end of the engine room and ahead of the engine frame. Passage from one engine to the other is had through a small doorway in the longitudinal bulkhead; a sliding door here, operated from either deck, may be instantly closed.

Descending by four or five steps, passing through a doorway in the cross bulkhead and along a slightly inclined and narrow passage between the boilers, we find ourselves in the after stoke hold. Here the boiler furnaces face each other all across the ship, with sufficient room between for the stokers to work. The coal is taken from the bunkers at each side. Passing forward again between the boilers and through another bulkhead, we come to the next stoke hold, and so on. There was, at the time of our visit, no suggestion of heat or the consequent discomfort and actual suffering endured by the stokers, as all the fires were out and the boilers were cold.

The total working force of the ship is 459 persons. There are 90 stokers, 75 coal passers, 18 oilers and 17 engineers. The stokers and coal passers work four hours and rest eight, alternately.

It may be well for us to add a few to the figures previously given concerning this wonderful ship. The diameters of the cylinders of the four-cylinder, triple-expansion engines are: High-pressure, 52 inches; intermediate, 89¾ inches; two low-pressure, 96½ inches. The maximum horse-power made on the voyage over was 28,430, at 77 revolutions and 186 pounds boiler pressure.

The actuating cylinders of the air pumps are 18 inches diameter and 24 inches stroke; the single-acting air cylinders are 44 inches diameter, with the same stroke. They may be run at any speed necessary up to 75 double strokes per minute. In economy and efficiency these pumps are said to have a record of 1-10 of 1 per cent. of the I. H. P. of the main engines. The two condensers on the ship have 11,060 tubes, comprising a total length of thirty-five miles.

Of the beauty and completeness of the ship it is not for us to speak. Nothing about the ship in any way suggests any slighting of any part for the sake of the engines. Every known concomitant of luxurious travel is provided. The first-class cabins have, of course, the best of the ship, the staterooms being amidship and also mostly on the main deck. Bilge keels steady the hull, so that there is less rolling than is generally encountered, in this respect the human passengers being treated with as much consideration as has been for some time accorded to cattle on their special steamers.

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Erratum.

An annoying error slipped into the article on Foreign Practice in Engine Proportions, which appeared in our issue for September 23d. In two cases pressures in kilos per square centimeter were made to read in kilos per square inch. Our readers would naturally use the translations given into pounds per square inch, which were given correctly; but the expressions printed may have led some to doubt the reliability of the data, and on that account we make the correction.

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At his recent visit to the works of the General Electric Company, at Schenectady, N. Y., Lord Kelvin said: "I am enjoying myself very much and learning enormously. There are no shops in the world like these; they are among the great wonders of America."

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(147) W. S., Middletown, Conn., asks: Can you tell me of some way of cleaning the windows of a machine shop, which have not been cleaned for some years, and are covered with iron rust? I have tried several ways, but it takes too long. Perhaps you or some of your readers can help me out. A.—If you will look in our issue of April 11, 1889, you will find the method adopted by the Fitchburg Machine Company described, and which we believe was invented by the superintendent, Mr. Gammell, for this job. It consists of using simply a solution of oxalic acid, instead of clear water, and is very efficient for the purpose.

(148) M. J. W., Leadville, Col., asks: Are there any standard tables or rules for determining the sizes of all standard gas-pipe fittings, including those up to 12 x 12 x 8 inches; that is, standards for the various dimensions, such as length over all and distance from center of one pipe to end of thread on another? A.—We referred this question to Mr. Carleton W. Nason, of the Nason Manufacturing Company, who has in his business, and also as chairman of a committee of the A. S. M. E. appointed for that purpose, given much attention to the question of the standardization of pipe fittings, flanges, etc. He replies as follows: "I regret to say that there is no standard of dimensions for lengths of fittings of any size, whether it be 12-inch, 8-inch or less. No two manufacturers use the same scale, and so much has already been spent in patterns that I doubt very much if alterations will ever be made which will make anything like agreement between the different manufacturers. It is unfortunate that this is the case, especially with fittings of the larger sizes, for if there was a standard it would enable users to cut pipe to measurements without having to measure fittings; but I think that the irregularities have now gone so far that it is too late to attempt to modify them or to standardize measurements of cast-iron fittings."

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Personal.

We will consider it as a favor if our readers will send in items of news regarding changes of foremen, superintendents or others prominently connected with the machine business. Such items are legitimate news of the trade, and we are glad to make room for them.

Passed Assistant Engineer J. S. McKean, U. S. N., has been detached from the Minneapolis with three months' leave.

Mr. Ambrose Swasey, of Warner & Swasey, Cleveland, O., recently returned from his European trip, having been away from this country for about five months.

Mr. Theo. H. Hadley, who for several years has been superintendent of the machine shop of the Ames Iron Works, Oswego, N. Y., has accepted a similar position with the Fischer Foundry & Machine Co., Pittsburg, Pa.

Commercial Review.

NEW YORK, Saturday Evening, Oct. 2.

MACHINIST'S SUPPLIES.

Among the houses in this city which devote themselves to the wholesale and retail supply of mills, machine shops and factories with the minor lines of equipments, trade broadens conservatively. Demand varies from poor to excellent, but appears, on the whole, to be making important gains, though not with a rush.

The consumption is not yet heavy enough to have affected prices materially. There is, however, more or less talk of higher prices all the time, and in some few lines actual advances have taken place. Iron pipe has been on the increase, and belting is said to be likely to advance shortly, as hides have done; but it is not safe to count upon an advance until it is

(*Continued on page 39.*)

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Business Specials.

Gear wheels, gear cutting. Grant; see page 20.

Special Brass Work. H. D. Phelps, Ansonia, Conn.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct

Brass ptn. letters & figs. for sweat'g on metal ptns. H. W. Knight & Son, Seneca Falls, N. Y., Drawer No. 12.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y

Cost of Manufacturing—Experienced manager will establish system of costs, giving exact account of every detail. Charge based on saving effected. Correspondence solicited. Geo. C. Thomas, 99 Nassau Street, New York, Room 212.

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Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy shou'd be sent to reach us not later than Saturday Morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Pr'c. to'l. & draft. w'nts work. Box 218, AM. MACH.

First-class loco. dftmn. des. pos. Box 25, AM. MACH.

Pat. m'k'r wants pos.; 5 yrs exp. Box 19, AM. MACH.

Mech. draughtsman, shop and drawing room experience, desires to change. Box 22, AMER. MACH.

Experienced mech. draftsman, tech. grad., moderate salary, desires position. Box 23, AMER. MACH.

Young man wants to learn machinist's trade in small shop; good references. Box 4, AMER. MACH.

Mach., married, sober, comp., exp. lathe & bench, brass w'k., mfg. sml. intrchbl. parts, eng. building. A. S. McNutt, 232 Fountain Ave., Brooklyn, N. Y.

Pos. as chief engineer to foreign country. Will take 5 yrs. contract; ref. given and required; exp. in erecting and handling men. Box 20, AM. MACH.

A comp., reliable and skilled machinist (39), with wide spread experience and fine faculties as foreman, des. eng. Address Box 21, AMER. MACHINIST.

Machinist—Toolmaker on up-to-date stamping work, also experience in building fine automatic machines; foreman in last place. Box 16, AM. MACH.

Foreman machinist desires position; marine engines and heavy mach'y; can refer to largest establishments on Atlantic Coast. Ad. Box 17, AM. MACH.

A successful designer of light machinery and tools, with executive ability and several years' shop experience, wants a position as superintendent. Address "Illinois," care AMERICAN MACHINIST.

Sit. wanted as manager, supt. or assist. of mach. shop, bicy. or other mfg. plant, by competent man with over 12 years practical experience in such capacity. Is well up in mod. mach. shop prac.; systematic; a hard worker, with A1 executive ability; all-around prac. mach., patternmaker, draughtsman and designer. Any good position where merited advancement is possible is acceptable; best of ref. C. F. Pease, 1373 W. Harrison St., Chicago.

Help Wanted.

Wanted—A first-class experienced tool maker, one who is up in mod. methods. Box 2, AM. MACH.

Wanted—An expert on gas engines one who has had large experience and can handle men; none other need apply. Box 15, AMERICAN MACHINIST.

Wanted—Man with experience in machine tool business capable of taking charge of 50 men on vise and planer work. Good position open for right man. Address Box 24, AMERICAN MACHINIST.

Wanted, Salesman—A reliable man to sell our Tiger brands of lubricating oils and greases as a side line or exclusively; references required. Address, The Howard Oil & Grease Co., Cleveland, O.

Superintendent Wanted—Must have had experience as supt. of engine and boiler works; technical graduate preferred, other things being equal; must be able to handle men. We want to put some "go" into a conservative shop doing a good and profitable bus.; good sal. or share. Box 18, AM. MACH.

Wanted—A thoroughly prac. machinist to take charge of a small machine shop within three and a half miles of New York city hall. Must be a man competent to manufacture machinery similar to windmills, pumps, portable engines or mowing machines. Only those having experience with the gig system need apply. Address, by letter only, G. D. Eaton, 133 West Eighty-third St., New York, N. Y.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S. M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

For Sale—AMERICAN MACHINIST, 1882 to 1895 inclusive. Box 13, AMERICAN MACHINIST.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

6" calipers, 40c.; walnut tl. chests, 2 drw's. and till, $2.75. Hoffman Wks, 1909 Hoffman St., Philadelphia.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

For Sale—Small machine shop, having good repair trade, in town of 1,400 inhabitants; no opposition. Box 14, AMERICAN MACHINIST.

Model Locomotives—Complete castings, latest N. Y. Cen. standard, up to date; 4c. in stamps for cat. alog. G. H. Olney, 163 Herkimer St., Brooklyn, N. Y

Lathes, planers, drills, milling machines, vises, also brass working machinery second-hand; must be modern and in first-class condition. C. C. Wormer Machinery Co., Detroit, Mich.

For Sale—6 lathes, 2 boring mills, 1 planer, 4 drill presses, 3 emery wheel stands, shafting, pulleys, hangers, chain blocks, vises, drills, etc., all in good order. Address Box 853, Cincinnati, Ohio.

We have a factory equipped with machine tools and patterns for the mfr. of electric motors and dynamos. We want a competent man with capital to mfr. them. Address P. O. Box 1567, Boston, Mass.

For Sale—Gasoline and gas engine plant, one of the oldest manufactories of gasoline engines in this country; over 700 engines in operation; will bear investigation; good reasons for selling. Address Box 205, care of AMERICAN MACHINIST.

JUST PUBLISHED.

GAS, GASOLINE AND OIL ENGINES

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NORMAN W. HENLEY & CO.,
15 Beekman Street, New York.

Mechanical Engineers Wanted

LUDW. LOEWE & CO., BERLIN, GERMANY, wish to engage the following Engineers:

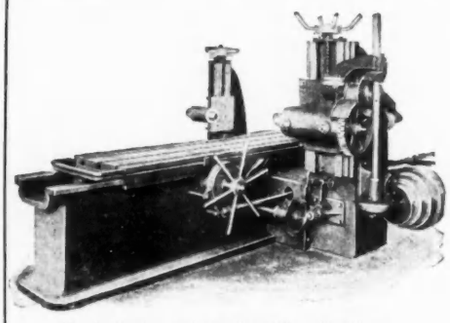
A MACHINE TOOL DESIGNER—One who is thoroughly experienced in the latest machine tool practice, and capable of designing a line of light machinery, like plain milling machines, lathes, drilling machines and a general line of light machinery adapted to modern manufacturing requirements, to be of the best quality and made in quantities. To design fixtures and jigs would not be required of this engineer, although a knowledge of this class of work would be necessary.

SMALL TOOL ENGINEER—One thoroughly acquainted with the latest designs in small tools, reamers, counterbores, cutters, taps, dies, etc. Must be capable of designing the best form of tools, to be manufactured in quantities, and to arrange plant for producing the same. A large new factory is now being erected especially for this branch.

SCREW MACHINE DESIGNER—One thoroughly acquainted with the latest practice in screw machine design, both hand and automatic. This Engineer to take charge of an entire department devoted to the designing and manufacture of screw machines.

The above positions are open to first-class men only. No communications can be considered unless explicit information is given, stating details as to experience, what positions have been filled and with whom, giving present position and references. Messrs. Ludw. Loewe & Co. are now erecting very large new works in Berlin, which are intended to be models in every respect. It is believed there are exceptional opportunities for good men. See "American Machinist" for July 22, 1897. Address H. F. L. Orcutt, 1183 Broad street, Hartford, Conn. Communications direct to the company will not receive attention.

J. M. ALLEN, President.
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary and Treasurer.



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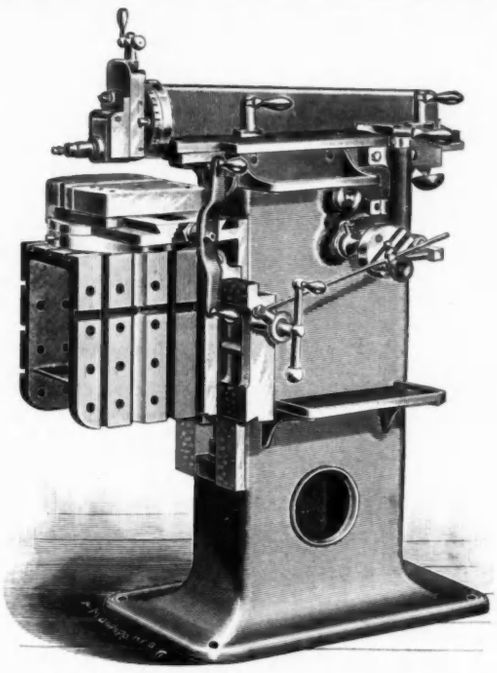
I have a BROTHER that can BORE.

Write to BEAMAN & SMITH,
Providence, R. I.

Van Norman's "Duplex" Bench Milling Machines

For Tool Makers and Small Work.

Waltham Watch Tool Co., Springfield, Mass., or WALTER H. FOSTER, 126 Liberty St., N.Y.



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Die Work, Tool Room or General Shop Work.

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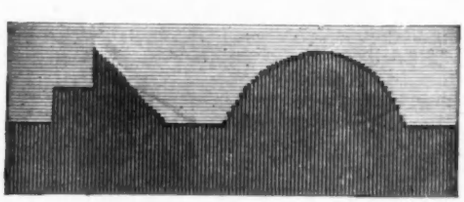
The stroke can be adjusted for curves with machine in motion. The stroke can be adjusted for angles with machine in motion. The stroke can be adjusted for irregular work with machine in motion. It has adjustable table for planing taper work; table can be removed for fastening work to apron. Has a strong graduated swivel vise. Quick work, rapid changes, modern ideas.



This cut shows how stroke can be adjusted with machine in motion by micrometer; adjustment fine and delicate. SEND FOR CIRCULAR.

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European Agents, SCHUCHARDT & SCHUTTE, Berlin, Vienna, Brussels, Stockholm.
CHAS. CHURCHILL & CO., Ltd., London, and Birmingham, Eng.
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EUGEN SOLLER, Basel, Switzerland.

actually made. Machine screws have been weak, but we understand, are a trifle firmer. A line in which some unstability is manifested, as a result of competition, is sand and emery paper.

The Eastern manager of a Western company spoke to us yesterday in rather a bullish tone regarding the tendency of prices. "A year ago," said he, "manufacturers were only upon a staying basis. If they received enough for their goods to keep their business afloat, waiting for better times, it was about all they could do. Now, however, conditions have changed, and they are in a position to raise their quotations. Raw materials are going up, and they will be justified by the demand in raising the finished products as well, and will be enabled to retrieve past losses. The raw materials in our line have advanced within six—indeed, we may perhaps say within three—months, and before long we shall probably ask more for our goods. This may not be done all at once, but by gradual modifications of our discounts."

Nevertheless we think that before sellers begin to pull very hard upon prices they will have to get more of the slack out of the rope than they have managed to do yet; but it may not take long to do it. The way in which quotations on iron are taking steps is certainly encouraging, and if that thing keeps on much further, finished products will have to make some move in sympathy.

POWER TRANSMITTING MACHINERY.

Companies engaged in this line of trade report an improving business. There have for some time been a fair number of inquiries on hand, and many of them have not been closed up, but those that are being closed seem to be gradually increasing in volume. Among the various branches of industry which have been in the market may be mentioned the electrical, chemical, sugar refining, silk and woolen mills, grain elevators, etc. In the last mentioned line the Dodge Manufacturing Company have a large valuation of work on their books, and also have been engaged upon constructing rope drives—eighteen or twenty in all—for a big coal-breaker plant at Lattimer, Pa. The works are running on night and day time.

In this connection we may mention having received information that the Rochester & Pittsburg Coal & Iron Company is to erect at Punxatawney, Pa., a coal-washing plant which, it is said, will be the largest and most complete in the country. The Luhrig system is to be employed, Cunninghame & Co., Cincinnati, are the contractors, and the Link Belt Machinery Company, of Chicago, will supply the machinery.

The Saginaw Manufacturing Company, who manufacture wood pulleys and other wooden ware, have been considerably occupied with export work, and

have had such a large volume of foreign correspondence—much of it voluntary—that they have felt justified in the preparation of a fine assortment of samples and the despatch of a representative to Europe. Mr. Boutel, secretary and treasurer of the company, has accordingly started.

MISCELLANEOUS NOTES.

We hear from the Jones & Lamson Machine Company, Springfield, Vt., makers of the flat turret lathe and its tools, that they have gone on full time, after running only thirty-two hours per week since February, and on short time for over one year. September sales were of more than double the average for the eight months preceding, due to increase in American orders.

The head of one of the largest supply and small tool houses about here remarks: "Our business is certainly good. Trade seems to be excellent in some places and poor in others. Some of our traveling men come in and say that it is booming; others, that they cannot sell anything. I have just returned from the West, and did not find industry generally very active there. Chicago is dull; but a pump company I visited in Michigan were rushed with work, and were adding to their plant. Yet, as they manufacture a specialty, they may not be a perfect criterion of the market. In Philadelphia it is just like Sunday. Although you may suggest that this is the normal condition of the city, yet that is hardly the case, for, although they may not rush around very much in securing trade, a large volume of goods is accustomed to change hands there."

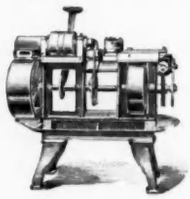
The point of view makes a vast amount of difference in drawing conclusions. A man returned from New England, and from Philadelphia, Washington, Hagerstown, etc., speaks of good business in these quarters; while another from Western New York considers that business is dull there, which is quite unlike the experience of another reported last week.

PITTSBURG REPORT FOR SEPTEMBER.

A revival in all lines of business is eagerly looked for since the settlement of the coal strike. Mills are running more actively, and numerous plants which were idle for many months are again raising steam, preparatory to a continuous run. All but one of the furnaces in the Mahoning Valley are in blast. Four months ago, all but three were out of blast. Before resuming, several of the furnaces were equipped with such appliances as to increase the output 10 per cent. The production of iron in Western Pennsylvania and Eastern Ohio is something enormous, while the consumption is equally as great. Few furnaces have any large amount of stock on hand. Prices are gradually stronger. The latest quotation was $10.75 @ 11.00 for No. 1 foundry iron, and $10.25 @ 10.50 for No. 2. Bes-

(Continued on page 41.)

Spencer Automatic Screw Machines



in eleven sizes, for Making Screws, Studs, Bicycle Hubs and other pieces of circular cross-section and various outlines from bars of round, square, or hexagon metal, in diameter 1/16 to 3 1/16 inches.

All needed adjustments are provided for. One boy may attend a half dozen machines.

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ARE YOU LOOKING for a lathe? We are building them in various sizes from 9 in. to 15 in. swing, in various lengths, both engine and speed lathes. Our designs are the **latest**, while the **workmanship, material** and **finish** are of the **highest** order. Our catalogue will tell you all about them, as well as of our planers, shapers and other tools.

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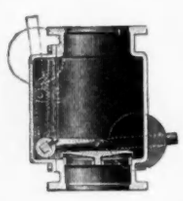

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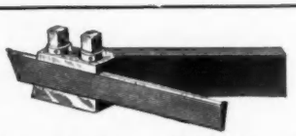

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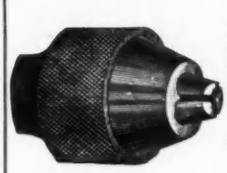

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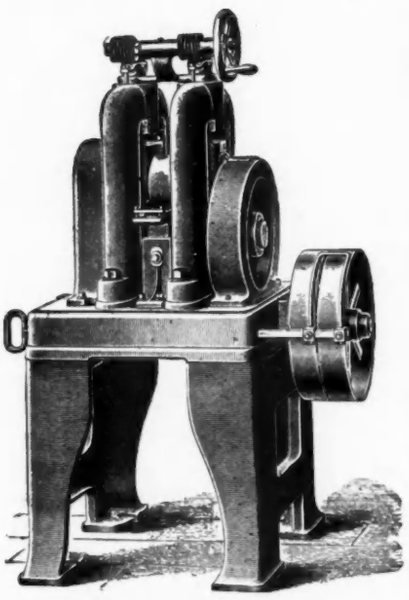

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S. LEWIS JONES, Supt.
Exhibition Department.

MAKE EARLY APPLICATION FOR SPACE.

(Continued from page 40.)

semer iron has advanced quite rapidly of late. The best figure to be obtained is $10.75 @ 11.00.

In the numerous foundries of this vicinity far more men are now employed than for months past. Molders are, to some extent, in demand, and pattern makers have been kept busy working overtime. A large amount of iron is consumed daily, and founders are taking advantage of the present prices of iron, fearing that there will be continued advances in the selling prices of the different grades. The castings made are generally of the light order, there being no extremely heavy ones in the market. The roll works are fairly well employed, mostly on duplicate work.

In the machinery lines there are more inquiries going with fair prospects of closing many of them before the end of the present year. At present there are three or four tin mills to be erected within a radius of 100 miles of Pittsburg. Many of the rolling mills and steel works are preparing greatly to enlarge their capacity, while at all times there are parties increasing the driving power of plants. McGill & Co., of Pittsburg, recently made shipment of a large amount of machinery to Russia, to be installed in the new steel plant at Mariopol. The Frank Kneeland Machine Company and other rolling mill machine builders have made heavy shipments during the past month. The West Leechburg, Pa., Iron & Steel Company intends building a plant for which an entire equipment of machinery will be wanted. The striking employés of the Scottdale, Pa., Iron & Steel Company have raised $135,000 stock and are preparing plans for the location of a sheet mill at Scottdale. Somerton Bros., of Brooklyn, N. Y., are seeking a site in Western Pennsylvania for the removal of their works. Their idea in moving is to secure cheaper fuel and be nearer the raw material market.

Quotations.

NEW YORK, Monday, October 4.

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No. 2 foundry, Northern	11 25 @ 11 50
No. 2 plain, Northern	10 90 @ 11 00
Gray forge, Northern	10 25 @ 10 50
No. 1 foundry, Southern	11 00 @ 11 25
No. 2 foundry, Southern	10 75 @ 11 00
No. 3 foundry, Southern	10 25 @ 10 75
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Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.05c.; refined, 1.15 @ 1.20c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.30 @ 1.45c.

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Machinery Steel—Ordinary brands, from store, in small lots, 1.60 @ 1.70c.

Cold Rolled Steel Shafting—Base size, from store, in small lots, 2.15 @ 2.25c.

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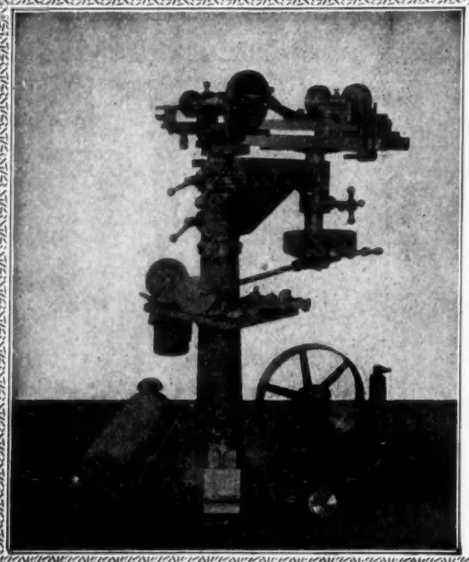
Sub-pressed Dies,
Setting Dies,
Soft Punches and Dies,
Speed of Punches,
Triple Dies, Etc., Etc.



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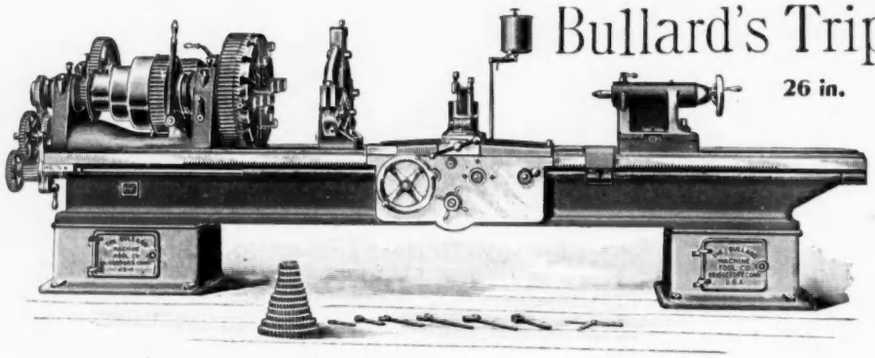

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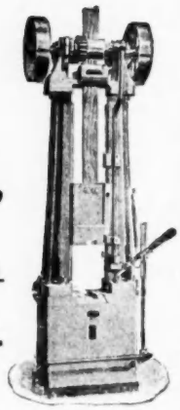
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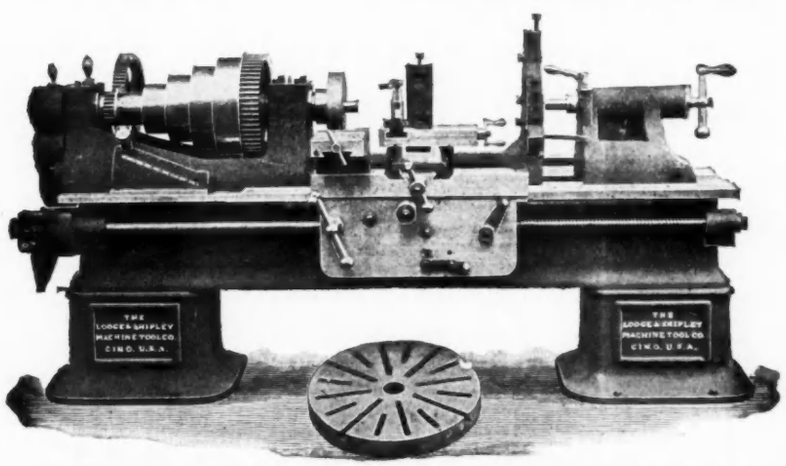

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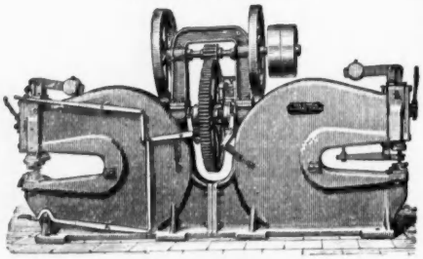

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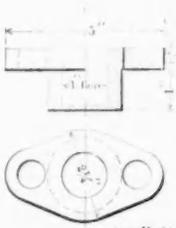

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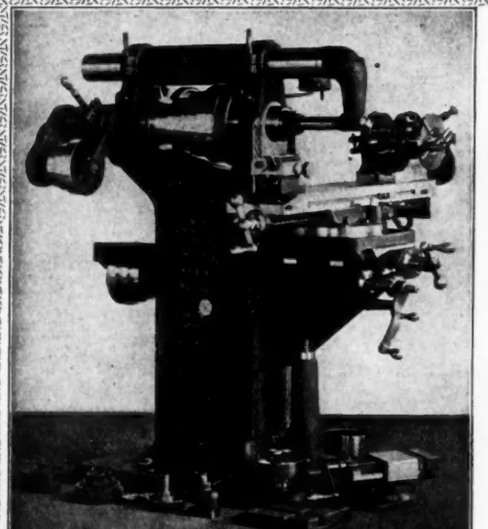

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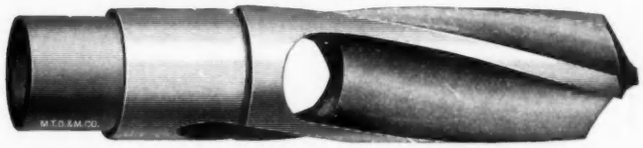

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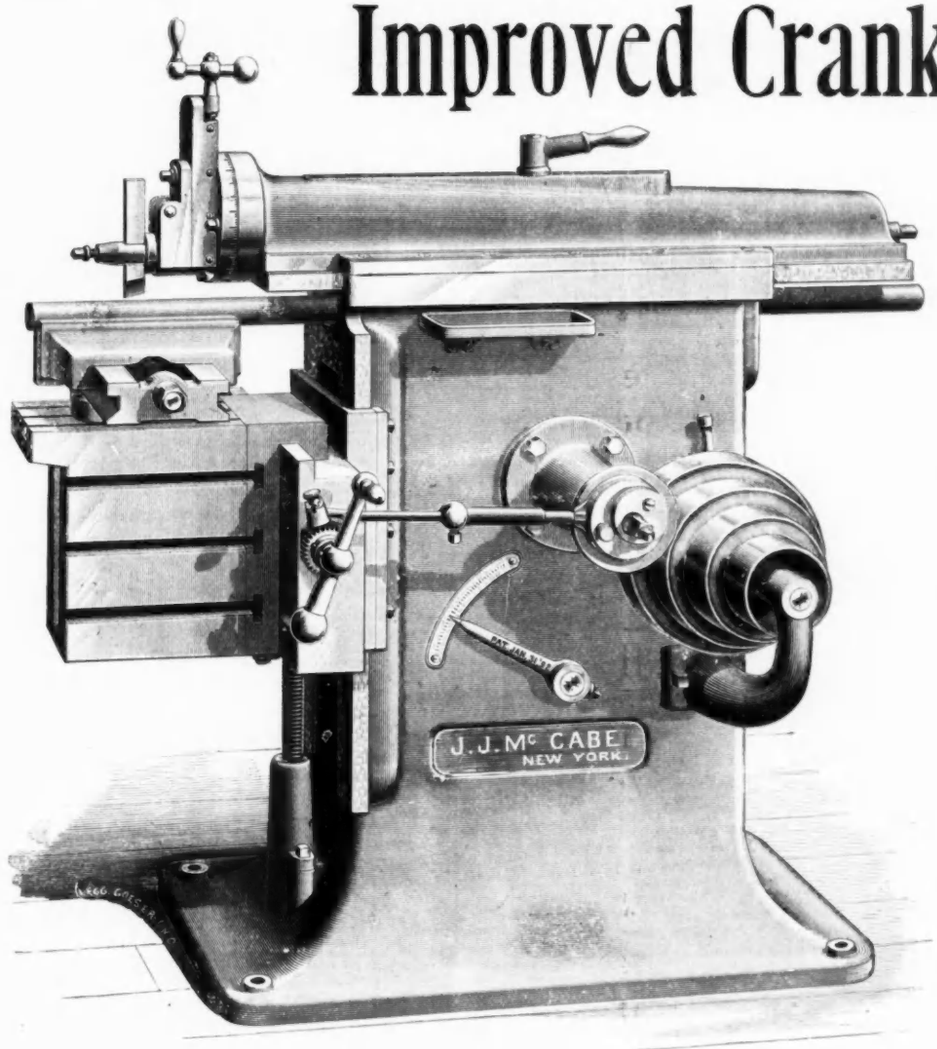

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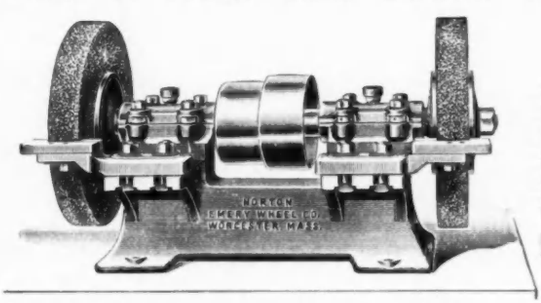

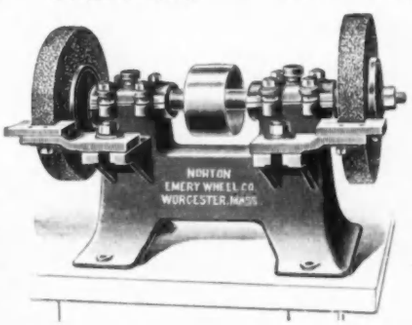

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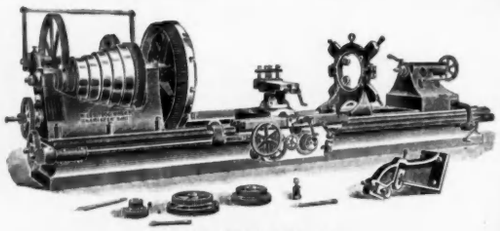

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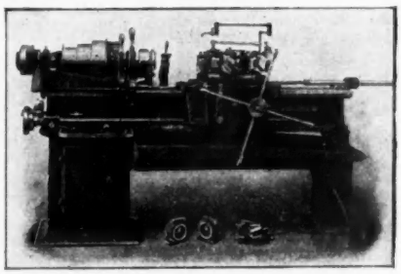

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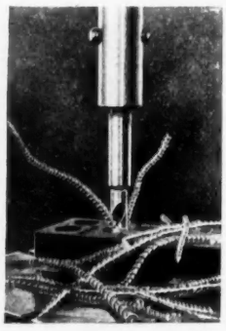

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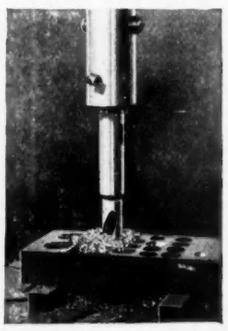

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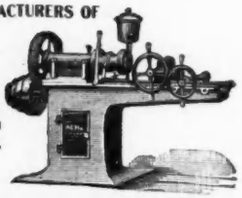

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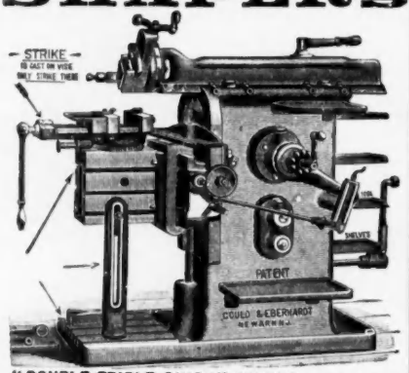

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